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ABSTRACT

These Illinois skill standards for agriculture machinery service technician are intended to serve as a guide to workforce preparation program providers as they define content for their programs and to employers as they establish the skills and standards necessary for job acquisition. They could also serve as a mechanism for communication among education, business, industry, and labor. An introduction provides a sample format and occupational earnings and employment information. Each skill standard contains these components: performance area; coding that identifies the state, fiscal year in which the standard was endorsed, subcouncil abbreviation, cluster abbreviation, and standard number; conditions of performance; work to be performed; performance criteria; performance elements; and performance assessment criteria, including product and process. The 80 skill standards are categorized into these 8 areas: initial set up (4 standards); harvesting equipment (4); heating, air conditioning, and ventilation (9); engine service (17); electrical system service (12); power train service (18); hydraulic system service (7); and steering, brakes, chassis, and frame service (9). (YLB)

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ED 473 317

ILLINOIS OCCUPATIONAL SKILL STANDARDS

AGRICULTURE MACHINERY SERVICE TECHNICIAN

Endorsed for Illinois
by the
Illinois Occupational Skill Standards and
Credentialing Council

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A MESSAGE FROM THE ILLINOIS OCCUPATIONAL SKILL STANDARDS AND CREDENTIALING COUNCIL

Preparing youth and adults to enter the workforce and to be able to contribute to society throughout their lives is critical to the economy of Illinois. Public and private interest in establishing national and state systems of industry-driven skill standards and credentials is growing in the United States, especially for occupations that require less than a four-year college degree. This interest stems from the understanding that the United States will increasingly compete internationally and the need to increase the skills and productivity of the front-line workforce. The major purpose of skill standards is to promote education and training investment and ensure that this education and training enables students and workers to meet industry standards that are benchmarked to our major international competitors.

The Illinois Occupational Skill Standards and Credentialing Council (IOSSCC) has been working with industry subcouncils, the Illinois State Board of Education and other partnering agencies to adopt, adapt and/or develop skill standards for high-demand occupations. Skill standards products are being developed for a myriad of industries, occupational clusters and occupations. This document represents the collaborative effort of the Agriculture and Natural Resources Subcouncil, and the Agriculture Machinery Service Technician Standards Development Committee.

These skill standards will serve as a guide to workforce preparation program providers in defining content for their programs and to employers to establish the skills and standards necessary for job acquisition. These standards will also serve as a mechanism for communication among education, business, industry and labor.

We encourage you to review these standards and share your comments. This effort has involved a great many people from business, industry and labor. Comments regarding their usefulness in curriculum and assessment design, as well as your needs for in-service and technical assistance in their implementation are critical to our efforts to move forward and improve the documents.

Questions concerning this document may be directed to:

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We look forward to your comments.

Sincerely,

The Members of the IOSSCC

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THE ILLINOIS PERSPECTIVE

The Occupational Skill Standards Act (PA 87-1210) established the nine-member Illinois Occupational Skill Standards and Credentialing Council (IOSSCC). Members of the IOSSCC represent business, industry and labor and are appointed by the Governor or State Superintendent of Education. The IOSSCC, working with the Illinois State Board of Education, Illinois Community College Board, Illinois Board of Higher Education, Illinois Department of Employment Security and Illinois Department of Commerce and Community Affairs, has created a common vision for workforce development in Illinois.

VISION

It is the vision of the IOSSCC to develop a statewide system of industry defined and recognized skill standards and credentials for all major skilled occupations providing strong employment and earnings opportunities in Illinois.

The IOSSCC endorses occupational skill standards and credentialing systems for occupations that

- require basic workplace skills and technical training,
- provide a large number of jobs with either moderate or high earnings, and
- provide career advancement opportunities to related occupations with moderate or high earnings.

Subcouncils and Standards Development Committees

Under the direction of the IOSSCC, and in cooperation with industry organizations and associations, industry subcouncils have been formed to review, approve and promote occupational skill standards and credentialing systems. The industry subcouncils are: Agriculture and Natural Resources; Applied Science and Engineering;* Business and Administrative Information Services; Communications; Construction;* Education and Training Services;* Energy and Utilities;* Financial Services; Health and Social Services; Hospitality; Legal and Protective Services;* Manufacturing; Marketing and Retail Trade; and Transportation, Distribution and Logistics. (*Indicates subcouncils identified for future development.)

Standards development committees are composed of business, labor and education representatives who are experts in the related occupational cluster. They work with the product developer to

- develop or validate occupational skill standards,
- identify related academic skills,
- develop or review assessment or credentialing approaches, and
- recommend endorsement of the standards and credentialing system to the industry subcouncil.

Expected Benefits

The intent of skill standards and credentialing systems is to promote education and training investment and ensure that students and workers are trained to meet industry standards that are benchmarked to the state's major international competitors. Skill standards and credentialing systems have major benefits that impact students and workers, employers and educators in Illinois.

Student and Worker Benefits

- Help workers make better decisions about the training they need to advance their careers
- Allow workers to communicate more effectively to employers what they know and can do
- Improve long-term employability by helping workers move more easily among work roles
- Enable workers to help their children make effective academic and career and technical decisions

Employer Benefits

- Focus the investment in training and reduce training costs
- Boost quality and productivity and create a more flexible workforce
- Improve employee retention
- Improve supplier performance
- Enlarge the pool of skilled workers

Educator Benefits

- Keep abreast of a rapidly changing workplace
- Contribute to curriculum and program development
- Provide students with better career advice
- Strengthen the relationship between schools and local businesses
- Communicate with parents because educators have up-to-date information about industry needs

The IOSSCC is currently working with the Illinois State Board of Education and other state agencies to integrate the occupational standards with the Illinois Learning Standards which describe what students should know and be able to do as a result of their education. The IOSSCC is also working to integrate workplace skills—problem solving, critical thinking, teamwork, etc.—with both the Illinois Learning Standards and the Illinois Occupational Skill Standards.

IOSSCC Requirements for Occupational Skill

Illinois Occupational Skill Standards define what an individual should know and the expected level of performance required in an occupational setting. They focus on the most critical work performances for an occupation or occupational area.

Any occupational skill standards and credentialing system seeking IOSSCC endorsement must

- represent an occupation or occupational cluster that meets the criteria for IOSSCC endorsement, including economic development, earnings potential and job outlook;
- address both content and performance standards for critical work functions and activities for an occupation or occupational area;
- ensure formal validation and endorsement by a representative group of employers and workers within an industry;
- provide for review, modification and revalidation by an industry group a minimum of once every five years;
- award credentials based on assessment approaches that are supported and endorsed by the industry and consistent with nationally recognized guidelines for validity and reliability;
- provide widespread access and information to the general public in Illinois; and
- include marketing and promotion by the industry in cooperation with the partner state agencies.

Occupations that do not meet the earnings criteria for IOSSCC endorsement but are part of an occupational cluster that is being developed may be presented for recognition by the IOSSCC. IOSSCC members encourage individuals to pursue occupational opportunities identified as endorsed occupations. Examples of occupations that do not meet the endorsement criteria, but have been recognized by the IOSSCC are Certified Nurse Assistant and Physical Therapy Aide.

Skill Standards Components

Illinois Occupational Skill Standards must contain the following components:

- Performance Area
- Performance Skill
- Skill Standard
- Performance Elements
- Performance Assessment Criteria

The IOSSCC further identified three components (*Conditions of Performance, Statement of Work and Performance Criteria)* of the Skill Standard component as critical work functions for an occupation or industry/occupational area. The sample format for Illinois Occupational Skill Standards on the following page provides a description of each component of an occupational skill standard.

The sample format also illustrates the coding at the top of each page identifying the state, fiscal year in which standards were endorsed, subcouncil abbreviation, cluster abbreviation and standard number. For example, the twenty-fifth skill standard in the Agriculture Machinery Service Technician, which has been developed by the Agriculture and Natural Resources Subcouncil, would carry the following coding: IL.00.ANR.AMST.25.

SUMMARY OF WORK TO BE PERFORMED. SUMMARY IS BRIEF AND BEGINS WITH AN ACTION VERB.

IL.FY.SUBCOUNCIL. CLUSTER. STANDARD NO.

PERFORMANCE AREA

SKILL STANDARD

CONDITIONS OF PERFORMANCE

A comprehensive listing of the information, tools, equipment and other resources provided to the person(s) performing the work.

WORK TO BE PERFORMED

An overview of the work to be performed in demonstrating the performance skill standard. This overview should address the major components of the performance. The detailed elements or steps of the performance are listed under "Performance Elements."

PERFORMANCE CRITERIA

The assessment criteria used to evaluate whether the performance meets the standard. Performance criteria specify product/outcome characteristics (e.g., accuracy levels, appearance, results, etc.) and process or procedure requirements (e.g., safety requirements, time requirements, etc.).

PERFORMANCE ELEMENTS

Description of the major elements or steps of the overall performance and any special assessment criteria associated with each element.

PERFORMANCE ASSESSMENT CRITERIA

Listing of required testing, certification and/or licensing.

Product and process used to evaluate the performance of the standard.

PRODUCT

Description of the product resulting from the performance of the skill standard.

PROCESS

Listing of steps from the Performance Elements which must be performed or the required order or performance for meeting the standard.

OCCUPATIONAL EARNINGS AND EMPLOYMENT INFORMATION FOR AGRICULTURE MACHINERY SERVICE TECHNICIAN

I. Developmental Process and Occupational Definition

A. Developmental Process

After studying labor market information, the Agriculture and Natural Resources Subcouncil recommended Agriculture Machinery Service Technician be an occupational area for which performance skill standards would be developed. This occupational area meets the criteria established by the Illinois Occupational Skill Standards and Credentialing Council (IOSSCC) for performance skill standard development, education and training requirements, employment opportunities, earnings potential and career opportunities.

1. Resources

The Agriculture Machinery Service Technician standards were based on descriptions and competencies addressed in related educational programs and common and accepted references. Texts and technical service manuals provided reinforcements for the direction given in the framework.

2. Standards Development Committee

A Standards Development Committee, composed of service technicians and service center managers, was convened. The framework, initial outline, matrix and draft skill standards were presented to the standards development committee for review, revision, adjustment and validation. At a third and final meeting, educators reviewed the skill standards for consistency in terminology and the assessment criteria for content.

B. Occupational Definition

Agriculture Machinery Service Technicians maintain and repair agricultural equipment such as planting and tillage equipment, tractors, combines and balers. Duties include preventative maintenance, diagnosis of failures, adjustment and repair or replacement of parts. Some technicians specialize in engine overhaul, transmission work or the repair of a particular piece of equipment. They may also assemble new machinery for equipment dealers.

II. Employment and Earnings Opportunities

A. Education and Training Requirements

Most employees prefer to hire technicians who have graduated from 2-year training programs in agricultural or diesel technology at community colleges. Skills can be acquired through apprenticeships, technical school and on the job.

B. Employment Opportunities

According to a recent survey conducted by the Midwest Equipment Dealers Association (MEDA), employment outlook is favorable for agriculture machinery technicians. The survey results indicate Illinois will require 1,110 new technicians before 2006. Also, a number of job openings will arise as experienced mechanics retire. Because of the increasing complexity of equipment being produced, technicians need a broad background in several different phases of equipment repair. This includes diesel technology and hydraulics. Jobs are often located in small towns and other non-metropolitan areas. Opportunities should be best for those with formal preparation.

C. Earnings Opportunities

	Middle Range Annual Earnings 2000*
Service Technicians	$24,383 - $41,886

**Middle range is the middle 50%, i.e., one-fourth of persons in the occupation earn below the bottom of the range and one-fourth of persons in the occupation earn above the top of the range.*

Sources: 2000 Midwest Equipment Dealers Association (MEDA) survey, United States Department of Labor, Bureau of Labor Statistics, 1999 Occupational Outlook Handbook.

III. Assessment and Credentialing Systems

The IOSSCC recognizes that industry commitment for third-party assessment is beneficial and requests that each standards development committee and/or subcouncil identify the most beneficial method for assessing the standards. This process will ensure that the training facility, instructor, curriculum and assessment methods meet industry needs and will prepare students to fully meet the identified standards.

IV. Industry Support and Commitment

The primary areas currently identified for industry support and commitment of occupational skill standards are development, updating and marketing. Business and industry partners may identify future uses of occupational skill standards such as credentialing/certification, career development of employees and specifications for out-source training programs.

A. Industry Commitment for Development and Updating

1. The development of skill standards for the agriculture machinery service technician is the efforts by the Agriculture and Natural Resources Subcouncil and the standards development committee. Names of the persons serving on the subcouncil and the standards development committee are located in the appendices.
2. In developing the products, the following steps were completed.
    a. Identification and prioritization of a career ladder, identifying jobs by name.
    b. Review of resources.
    c. Development of draft matrix of performance standards.
    d. Development of a performance standard that was identified on the matrix.
    e. Convening of standards development committee of incumbent workers.
    f. Review, validation and approval of skill standards by the standards development committee.
    g. Review and approval of standards by subcouncil.
    h. Endorsement of skill standards by the Illinois Occupational Skill Standards and Credentialing Committee (IOSSCC).
3. The Agriculture and Natural Resources Subcouncil supports a regular review and revision process to ensure the standards reflect the rapidly changing industry.

B. Industry Commitment for Marketing

The Agriculture and Natural Resources Subcouncil is committed to marketing and obtaining support and endorsement from the leading industry associations impacted by the skill standards.

Agriculture and Natural Resources Subcouncil members will coordinate efforts to provide awareness of the skill standards and obtain full industry commitment to this effort. In addition, the subcouncil will assist in developing a full industry- marketing plan

The Agriculture and Natural Resources subcouncil encourages the availability of skill standards to the public, including learners, parents, workers, educators at all levels, employers and industry personnel.

ASSUMPTIONS FOR AGRICULTURE MACHINERY SERVICE TECHNICIAN SKILL STANDARDS

Theory instruction and hands-on performance of all the basic tasks will provide initial training for employment in the agricultural machinery field or prepare one for further training in any or all of the specialty areas. Competency in the tasks will indicate to employers that the graduate is skilled in that area of performance.

Skill standards statements assume:

1. Workplace skills (employability skills) are expected of all individuals. Socialization skills needed for work are related to lifelong career experience and are not solely a part of the initial schooling process. These are not included with this set of statements.
2. Specific policies and procedures of the worksite will be made known to the individual and will be followed.
3. Time elements outlined for the skill standards result from the experience and consideration of the panel of experts who made up the standards development committee.
4. Skill standards describe the skill only and do not detail the background knowledge or theory related to the particular skill base. Although the skill standard enumerates steps to successful demonstration, rote approaches to the outcomes are not prescribed.
5. All work is completed in a safe and expedient manner.
6. Skill standards are selected because they meet workplace needs and are designed to meet professional standards of practice.
7. Skill standards do not replace or supersede nor substitute for procedure manuals.
8. Skill standards in no way supersede or take the place of certification or graduation from an accredited program of study.
9. In all areas, appropriate theory, safety and support instruction will be required for performing each task.
10. The identification and use of appropriate testing and measurement tools and equipment are incorporated into skill achievement.
11. Individuals are expected to know how to perform research and use industry reference and training materials.
12. All diagnostic and repair tasks are to be accomplished in accordance with the manufacturers' recommended procedures.
13. All diagnostic and repair time will be obtained from flat rate schedules derived from manufacturers, dealers or independent sources.
14. The term "correct" as used in this document refers to manufacturers' specifications.

SET UP CHISEL PLOW.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Set up a chisel plow from shipping condition to field performance operation.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Review appropriate documentation to determine correct serial number of unit and any accessory items to be installed.
7. Locate and move all components to be assembled to suitable level area.
8. Remove banding and packaging materials. Carefully unpack hardware and instructions.
9. Raise chisel plow frame and set on support stands.
10. Lift hitch and any wing extensions and attach to frame.
11. Attach wheels and tires to frame assembly.

12. Assemble all remaining structural and ground engaging components with specified hardware. Leave hardware loose until the complete unit is assembled to correct dimensions.
13. Torque all fasteners to specifications.
14. Attach hydraulic, valves, pipes, hoses, clamps, couplers and cylinders.
15. Attach all warning placards and safety lighting with required wiring harness.
16. Paint to touch up necessary areas.
17. Adjust tire pressure to specifications.
18. Hook an appropriate tractor to chisel plow and connect hydraulic and electrical connectors.
19. Cycle all hydraulic functions until air is removed.
20. Ensure that all hydraulic and mechanical functions operate correctly.
21. Check that safety lights operate correctly.
22. Make any necessary adjustments and lubricate all lube points.
23. Transport chisel plow to desired storage location and disconnect tractor.
24. Document any deficiencies and inform supervisor.
25. Return tools and equipment to proper location.
26. Clean up work area.
27. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Chisel plow is setup to field performance condition.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturer guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Set up seed planter from shipping condition to field performance condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Review appropriate documentation to determine correct serial number of unit, population and type of seed to be planted, any accessory items to be installed and desired row spacing of customer.
7. Locate and move all components to be assembled to suitable level area.
8. Remove banding and packaging materials. Carefully unpack hardware and instructions.
9. Move packing materials clear of assembly area.
10. Raise planter frame and set on support stands.
11. Lift hitch and any wing extensions and attach to frame.
12. Attach wheels and tires to frame assembly.

13. Adjust tire pressure to specifications.
14. Attach following items:
    a. Row units on correct spacing
    b. Seed containers
    c. Insecticide applicators on correct spacing
    d. Herbicide applicators on correct spacing
    e. Drive components
    f. Hydraulic components and plumbing
    g. Safety placards
    h. Safety lighting and wiring
    i. Markers
    j. Any ground engaging components
    k. All monitor and control devices
    l. Shields and covers
15. Paint to touch up necessary areas.
16. Ensure all fasteners are tight and torque required fasteners are as specified.
17. Lubricate all lube points.
18. Hook appropriate tractor to planter and connect all hydraulic and electrical connectors.
19. Cycle all hydraulic functions until air is removed.
20. Operate planter on soil surface to ensure all mechanical, hydraulic, electrical, monitoring and controlling functions operate correctly.
21. Make any necessary adjustments.
22. Transport planter to desired storage location and disconnect tractor.
23. Document any deficiencies and inform supervisor.
24. Return tools and equipment to proper location.
25. Clean up work area.
26. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Seed planter is setup to field performance condition.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Set up combine from shipping condition to field performance condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Review appropriate documentation to determine correct serial numbers of units, row spacing of customer, type of crop to be harvested first and accessory items to be installed.
6. Secure appropriate tools, equipment and components required to complete procedure.
7. Park combine on solid, level surface.
8. Remove shipping brackets and protective shields.
9. Set tire pressure to specifications.
10. Check steering axle toe and adjust if necessary.
11. Install and adjust ladders, lights, mirrors and slow moving vehicle placards and check operation.
12. Set wheels to correct spacing and direction.

13. Check coolant level, freeze protection, battery electrolyte level, battery post connections, belt tensions, engine oil level, air conditioning, heating and ventilation systems and correct or document any deficiencies.
14. Install accessories and check operation of steering, brakes, drive train, parking brake and operator's compartment features.
15. Check and, if necessary, adjust gear box fluid levels.
16. Grease and lubricate all points on combine and grain head.
17. Adjust feeder house for level.
18. Adjust feeder house chain tension.
19. Adjust concave to level and set minimum concave clearance stop and indicator.
20. Adjust chaffer, chaffer extension and sieve opening for average crop conditions.
21. Check tension and adjust all grain handling chains.
22. Program appropriate parameters into electronic monitor and control systems.
23. Start combine, check and, if necessary, adjust low and high engine speeds.
24. Operate unloading auger system and correct any deficiencies.
25. Check all gauges and monitor indicators for operation and repair as necessary.
26. Engage separator clutch (at low engine speed) and observe that belts, chains, bearings and clearances are within specifications.
27. Engage header clutch and observe header drive train for operation.
28. Move throttle to high governed position and check power takeoff speed and adjust, if necessary.
29. Adjust cleaning fan direction and speed to average crop conditions.
30. Adjust cylinder speed and concave cylinder spacing to average crop conditions.
31. Install correct weights on rear axle to match size of head to be used.
32. Program all parameters for electrical monitoring, controlling and global positioning of satellite systems and check system operation.
33. Touch up necessary areas using appropriate paint.
34. Document any deficiencies and inform supervisor.
35. Return tools and equipment to proper location.
36. Clean up work area.
37. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Combine is setup to field performance condition.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed depend on manufacturer, size and specific product being setup.

SET UP AND INSTALL SMALL GRAIN HEAD AND CORN HEAD.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Set up and install small grain and corn heads from shipping condition to field performance condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Review appropriate documentation to determine correct serial numbers of units, row spacing of customer, type of crop to be harvested first and accessory items to be installed.
7. Remove shipping brackets, protective shields and instructions.
8. Move packing materials clear of setup area.
9. Lower both heads carefully from shipping position to mounting position.
10. Adjust feeder house opening on both heads to match combine throat size.
11. Drive combine feeder house into small grain head and raise head high enough to engage feeder house cylinder stop.

12. Adjust small grain head lock brackets for feeder house and lock on feeder house.
13. Assemble small grain head and connect all fluid and electrical connectors.
14. Attach drive couplings and align support bearing brackets.
15. Adjust reel tine pitch to average crop conditions.
16. Bleed reel height, fore and aft stops with floating cutter bar in "up" position so that cutter bar has a minimum of one inch clearance with reel tines.
17. Check and adjust, if necessary, cutter bar knife registration.
18. Check and adjust gear box lube levels with head at correct height.
19. Grease and lubricate all lube points.
20. Engage separator and header clutch and observe header drive train for operation making sure cutter bar clearances are correct and not binding.
21. Drive combine with head on ground if necessary, to check and adjust operation and sensitivity of floating cutter bar system.
22. Remove small grain head, install corn head, align head lock brackets to feeder house, lock head on feeder house, attach drive couplings and align drive shaft support bearings.
23. Attach hydraulic and electrical connectors.
24. Check and adjust row spacing of stalk rolls, if necessary.
25. Install and level divider points.
26. Check and adjust level of fluid in gear boxes and lubricate all points with head in correct position.
27. Adjust stalk roll and stripper plate clearance to specifications.
28. Adjust tension and flight stagger of gathering chains to specifications.
29. Install any accessories on corn head.
30. Run corn head to check for correct operation and set row unit speed to average conditions.
31. Paint to touch up all necessary areas on both heads.
32. Program head parameters into combine electronic monitor and control systems and check system operation.
33. Document any deficiencies and inform supervisor.
34. Return tools and equipment to proper location.
35. Clean up work area.
36. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Small grain and corn heads are installed on combine and setup to field performance condition.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

CHECK CORN HARVESTING LOSSES.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Check losses of combine harvesting corn.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Use brakes and speed-ratio lever to kill stop combine while combining corn in a representative part of field at least 300 feet in from ends of field.
7. Disengage separator clutch and immediately restart engine to cool before stopping.
8. Back up combine ten feet.
9. Measure total ear loss at rear end of machine.
10. Measure pre-harvest ear loss in unharvested area at front of machine.
11. Determine machine ear loss.
12. Measure total kernel loss at rear of machine.
13. Measure stalk roll kernel loss in harvested area at front of machine.
14. Determine separation and cylinder/rotor kernel loss.

15. Check grain in tank for excessive cracks and foreign material.
16. Check that there is approximately one tablespoon per flight made up of approximately one-half clean grain and one-half chaff and other crop material if tailings can be observed.
17. Look in separation and cleaning area for evidence of unthreshed grain, plugged or damaged screens or torn trash retarder curtains.
18. Determine if and what machine adjustments and operational changes should be made.
19. Return tools to proper location.
20. Clean up work area.
21. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Combine corn harvesting losses are determined.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Recondition combine and heads to reliable harvesting condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ask machinery owner details of any deficiencies.
7. Power wash complete machine with inspection doors open.
8. Check following listed areas of combine for specified clearances, chain condition and tension, belt and pulley condition, sprocket and bearing serviceability, seals, wear and bends, auger condition, plugged screens, inoperative controls, levelness, slip clutches, specified adjustment, wear and cracks or breaks:
   a. Feeder housing
   b. Rotor or cylinder and beater assembly
   c. Rotor cage, concaves and grates
   d. Straw walkers
   e. Auger bed

   f. Grain pan, chaffer and shoe sieve
   g. Cleaning fan
   h. Discharge beater
   i. Grain and tailings augers and elevators
   j. Straw chopper and spreader
   k. Grain tank and unloader systems

9. Make following checks and inspections on grain head:
   a. Reel tines and pitch
   b. Wear and adjustment of knife guard
   c. Wear and adjustment of knife hold down clips
   d. Wear plate and knife sections
   e. Knife registry
   f. Auger to stripper clearance
   g. Auger to bottom clearance
   h. Adjustment of retractable fingers
   i. Sprocket, pulley and bearings
10. Make following checks and inspections on corn head:
    a. Divider points for operation and damage
    b. Gathering chains and stripper shields
    c. Stalk roll knife wear and adjustment
    d. Stalk roll weed knives for sharpness and damage
    e. Auger to trough bottom adjustment
    f. Auger stripper adjustment
    g. Sprocket, pulley and bearings
11. Check operation and integrity of following systems:
    a. Electrical
    b. Hydraulic
    c. Drive train
    d. Brake
    e. Wheels and tires
    f. Steering
    g. Monitor and control
    h. Cooling
    i. Heating, ventilation and air conditioning
    j. Controls
    k. Engine and lubrication
    l. Communication and entertainment
    m. Lighting
    n. Exhaust
12. Check safety stands, ladders, wipers, doors, seats and windows.
13. Perform all scheduled maintenance.
14. Estimate parts and labor cost to correct all deficiencies.
15. Discuss all deficiencies and repair cost with owner and determine exact course of action owner authorizes.
16. Repair, replace or adjust deficiencies authorized by owner.
17. Paint to touch up necessary areas.
18. Operate machine and check operation of all systems.
19. Park combine and heads in assigned location.
20. Return tools to proper location.
21. Clean up work area.
22. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Combine and heads are reconditioned to a state that provides the owner reliable harvest operation.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY SQUARE BALER KNOTTER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Diagnose faulty square baler knotter using manufacturers' guidelines.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete the procedure.
6. Ask the owner or a representative to describe the type, frequency and associated events concerning the knotter deficiency.

7. Observe the baler in operation for the following knotter difficulty and probable causes:
   a. Knot in twine over bale.
   b. Twine broken in knot.
   c. Twine ends frayed.
   d. Knot too loose.
   e. Twine ends uneven.
   f. No knot on either twine.
   g. Knot in needle twine.
   h. Strands on one twine doubled back through knot.
   i. Twine bow knot.
   j. Twine cut or frayed behind knot
   k. Needle twine goes over billhook tongue roller.
   l. Needle twine goes under billhook tongue during first quarter of billhook travel.
   m. Knot does not strip off billhook.
8. Consult manufacturers' guidelines to determine appropriate remedy.
9. Determine necessary action.
10. Return tools to proper location.
11. Clean up the work area.
12. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty square baler knotter is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SPLICE ROUND BALER BELT.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Splice torn or broken round baler belt.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure belt-lacing kit, hooks and vice.
6. Loosen tension on bale chamber belts.
7. Remove belt to be spliced from baler.
8. Remove the damaged area.
9. Cut other end of belt square with edge of belt.
10. Select correct splice width.
11. Place hooks in belt-lacing die.

12. Place belt-lacing die in vise.
13. Align belt in center of hooks and hold it in the die.
14. Tighten vise to clinch hooks.
15. Remove belt from belt-lacing die.
16. Repeat Steps 10 through 15 for other end of belt.
17. Replace belt in baler and insert splice pin through belt hooks.
18. Place specified amount of tension on bale chamber belts.
19. Operate baler to check operation.
20. Return tools to proper location.
21. Clean up work area.
22. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Broken or torn round baler belt is spliced for further use.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY HEATER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Troubleshoot faulty heater.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Verify heater complaint.
8. Make following checks if insufficient heating is the complaint:
   a. Coolant level adequate
   b. Correct operation of engine cooling system thermostat
   c. Lack of obstruction in heater core or hoses
   d. Heater valve fully opening

   - e. All pressurizer blowers working correctly
   - f. Lack of obstruction in air inlet
   - g. Lack of excessive air leaks in operator's compartment
   - h. Coolant valve on engine fully opened to heater core
   - i. Lack of restriction in operator compartment air filters
   - j. Correct tension of water pump belt

9. Make following checks if excessive heat in operator's compartment is the complaint:
   - a. Inlet and outlet hoses routed correctly to heater core
   - b. Correct adjustment of heater core valve control mechanism
   - c. Integrity of operator compartment insulation
   - d. Excessive machine heat entering operator compartment
   - e. Correct operation of heater core valve
10. Pressurize engine cooling system with heater valve open and make following checks if sticky film forming on inside of operator compartment glass is the complaint:
    - a. Heater core leak
    - b. Loose hose clamps
    - c. Heater hose leaks
11. Compare all test results to manufacturers' guidelines to pinpoint fault.
12. Determine necessary action.
13. Return tools to proper location.
14. Clean up work area.
15. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty heater is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY AIR CONDITIONER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Troubleshoot faulty air conditioner.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure technician possesses correct and current certification credentials.
7. Inspect machine for safe operation.
8. Verify air conditioning complaint.

9. Inspect the following according to manufacturers' guidelines:
   a. Compressor mounting bracket
   b. Compressor, fan and coolant pump belt tension
   c. Cooling system inlet screens
   d. Fresh and recirculating air filters
   e. Heater valve position
   f. All blower fans on all speeds
   g. Over 40 degrees Fahrenheit, compressor clutch clicks on when key and blower switch are on with temperature control switch on maximum
   h. Lack of excessive air leaks in operator's compartment
   i. Heater hoses connected correctly
10. Check for the following with air conditioner on maximum, blower speed on low, cab closed and engine speed at 1500 revolutions per minute:
   a. Line from compressor to expansion valve or orifice tube is warm
   b. Line from expansion valve or orifice tube to compressor is cool
   c. Temperature at discharge duct is a minimum 20 degrees Fahrenheit below ambient
   d. Lack of excessive or abnormal noises from air conditioning components
   e. Frost on high side of system
11. Identify type of refrigerant being used.
12. Install correct air conditioner test gauges and, if equipped, mid-position service valves.
13. Check low and high side pressures.
14. Check clutch cycle "on" and "off" low side pressures.
15. Check for lack of bubbles if sight glass equipped.
16. Compare all test results with manufacturers' guidelines to determine if leak detection, flushing, evacuation, lubricant addition, charging, adjustment, or component repair or replacement is required to pinpoint fault.
17. Determine necessary action.
18. Return tools to proper location.
19. Clean up work area.
20. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

Technician must possess correct and current certification credentials.

PRODUCT

Faulty air conditioner is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

RECOVER REFRIGERANT.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Recover refrigerant from mobile air conditioning unit.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure technician possesses correct and current certification credentials.
7. Remove caps from high and low side service valves or ports.
8. Determine type of refrigerant being used.
9. Close both manifold valves on manifold gauge set.
10. Connect manifold gauge set red hose to high side service valve or port.
11. Connect manifold gauge set blue hose to low side service valve or port.
12. Mid-position high and low side service valves.

13. Connect manifold center hose to Underwriters' Laboratory approved recovery station for type of refrigerant used.
14. Assure the oil recovery cap is empty.
15. Follow recovery station manufacturers' instructions and recover all of refrigerant from system.
16. Measure amount of oil in station recovery cup and record.
17. Dispose of recovered refrigeration oil per regulations and replace empty recovery cup in recovery station.
18. Return tools to proper location.
19. Clean up work area.
20. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

Technician must possess correct and current certification credentials.

PRODUCT

Refrigerant is recovered from air conditioning unit.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturer guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Recycle refrigerant recovered from mobile air conditioning unit.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Time element is not appropriate for this skill. Time to complete skill varies depending on condition and quantity of refrigerant, type of recycling machine and environment where skill is performed.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure technician possesses correct and current certification credentials.

7. Follow manufacturers' guidelines to recycle refrigerant.
    a. If using Underwriters' Laboratory approved one-pass recovery recycle station, refrigerant is recycled to federal purity standards as it is recovered.
        1) When tank is 80 percent full, remove necessary non-condensables.
        2) Close tank valves and label tank to indicate it has been recycled, it is ready for use and type of refrigerant.
    b. If using an Underwriters' Laboratory approved multi-pass recovery recycle station, observe the following:
        1) When tank is 80 percent full, be certain liquid valve is fully open.
        2) Push rocker switch to recycle position.
        3) Momentarily depress cycle start button for three seconds.
        4) Leave unit in recycle mode until moisture indicator turns from yellow to green.
        5) Place rocker switch to end cycle position.
        6) Close liquid valve on tank.
        7) Let tank set for 12 hours at same temperature.
        8) Record temperature within four inches of tank.
        9) Use chart on station to remove necessary non-condensables from tank.
        10) Remove tank from station.
        11) Label tank to indicate type of refrigerant used, that it has been recycled and that it is ready to use.
8. Return tools to proper location.
9. Clean up work area.
10. Complete appropriate documentation according to shop policy and procedures.
11. Raise planter frame and set on support stands.
12. Lift hitch and any wing extensions and attach to frame.
13. Attach wheels and tires to frame assembly.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

Technician must possess correct and current certification credentials.

PRODUCT

Refrigerant recovered from mobile air conditioning unit is recycled to purity standards established by federal regulations.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Remove contaminants from air conditioner by flushing.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure technician possesses correct and current certification credentials.
7. Determine type of refrigerant in system.
8. Recover refrigerant from air conditioning system.
9. Isolate compressor, receiver-drier/accumulator, expansion valve or orifice tube from system.
10. Flush all components and hoses individually with environmentally safe and manufacturer recommended solvent.

11. Connect each component to pressurized flush solvent container, then open solvent tank liquid valve for 5 to 10 seconds to flush.
12. Repeat with all components.
13. Open inlet, discharge and drain port and add flush solvent through drain port if compressor is to be reused.
14. Shake compressor drain and install port plugs.
15. Purge each component with dry nitrogen for 5 to 20 seconds in same manner as flushing.
16. Install new orifice tube or cleaned expansion valve.
17. Install new receiver-drier/accumulator.
18. Add correct amount and type of fresh, uncontaminated lubricant to compressor inlet.
19. Install compressor.
20. Connect all hoses and fittings using new "o" rings and clean refrigerant lubricant.
21. Evacuate system.
22. Check system for leaks.
23. Charge system with correct type and amount of refrigerant.
24. Check system operation.
25. Return tools to proper location.
26. Clean up work area.
27. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

Technician must possess correct and current certification credentials.

PRODUCT

Air conditioner is cleaned of contaminants.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed depend on manufacturer, size and specific product being setup.

EVACUATE AIR CONDITIONER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Remove moisture and non-condensables from air conditioner by process of evacuation.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure technician possesses correct and current certification credentials.
7. Recover refrigerant from air conditioner.
8. Connect manifold set blue hose to low side service port.
9. Connect manifold set red hose to high side service port.
10. Connect manifold set center hose to vacuum pump capable of pulling a minimum of 28.6 inches of mercury at sea level and 70 degrees Fahrenheit.
11. Mid-position both service valves if applicable.

12. Open both manifold set handwheels.
13. Turn on vacuum pump.
14. Close both manifold handwheels when low side gauge reaches at least 28 inches of mercury.
15. Turn off vacuum pump.
16. Watch compound gauge to see that gauge does not rise at a rate faster than one inch of mercury in five minutes.
17. Check for leaks and repair if rise of compound gauge is not in specification.
18. Continue to run vacuum pump for a minimum of 45 minutes with vacuum of at least 28 inches of mercury at an ambient temperature of at least 70 degrees Fahrenheit.
19. Close both manifold handwheels.
20. Turn off vacuum pump.
21. Remove vacuum pump from center manifold hose.
22. Charge system with correct type and amount of refrigerant.
23. Check system operation.
24. Back seat service valves if applicable.
25. Remove manifold gauge set.
26. Install dust seals on service valves and ports.
27. Return tools to proper location.
28. Clean up work area.
29. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

Technician must possess correct and current certification credentials.

PRODUCT

Air conditioner is cleansed of excess moisture and non-condensables.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

ADD REFRIGERATION LUBRICANT.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Add refrigeration lubricant to air conditioning system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure technician possesses correct and current certification credentials.
7. Determine type of refrigerant in system.
8. Recover refrigerant from the air conditioning system.
9. Open up system and replace or repair necessary hoses and components.
10. Apply refrigeration lubricant as sealant and new "o" rings at refrigeration connections.
11. Isolate compressor and open inlet or drain port.
12. Determine exact amount of refrigeration lubricant to add to replace amount lost in removed components.

13. Determine from refrigerant type what type of refrigerant lubricant should be used.
14. Measure, from a fresh uncontaminated source, correct amount and type of refrigerant lubricant into clean squeeze bottle.
15. Squeeze measured lubricant into compressor drain or inlet port.
16. Install drain plug, inlet and discharge line on compressor.
17. Evacuate system.
18. Check system for leaks.
19. Charge system with correct type and amount of refrigerant.
20. Check system operation.
21. Return tools to proper location.
22. Clean up work area.
23. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

Technician must possess correct and current certification credentials.

PRODUCT

Correct amount and type of refrigeration lubricant is added to air conditioner.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Charge air conditioner with refrigerant.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure technician possesses correct and current certification credentials.
7. Determine type of refrigerant in system.
8. Recover refrigerant from air conditioning system.
9. Measure any lubricant that was removed and record amount.
10. Dispose of any lubricant that was removed.
11. Determine from machine data plate or manufacturer guidelines correct type and amount of refrigerant for full system charge.
12. Connect charging station appropriate for type of refrigerant to air conditioner.

13. Program unit to add correct amount of lubricant and refrigerant.
14. Program charging station to evacuate system for a minimum of 45 minutes at 70 degrees Fahrenheit ambient or higher.
15. Put vacuum pump on hold when pressure of 28 inches of mercury is obtained.
16. Check for leaks by observing if pressure rises faster than one inch of mercury in five minutes.
17. Add one pound of refrigerant and locate leak if a leak is detected.
18. Repair leak and repeat evacuation procedure.
19. Continue running vacuum pump, for a minimum of 45 minutes if no leaks are detected.
20. Add correct type and amount of lubricant and refrigerant to system.
21. Start engine, if necessary, and turn air conditioner on maximum until all refrigerant enters system from low side.
22. Check system operation.
23. Remove the charging station from system.
24. Install service port dust caps.
25. Return tools to proper location.
26. Clean up work area.
27. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

Technician must possess correct and current certification credentials.

PRODUCT

Air conditioner is charged.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE AIR CONDITIONER COMPRESSOR.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace faulty compressor on air conditioner.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure technician possesses correct and current certification credentials.
7. Determine type of refrigerant in system.
8. Recover refrigerant from air conditioning system.
9. Front seat both valves if system has service valves.
10. Remove refrigerant lines at compressor.
11. Remove electrical connections at compressor.
12. Remove electrical compressor drive belt.
13. Remove compressor from its mounting brackets.

14. Remove expansion valve or orifice tube.
15. Remove receiver-drier/accumulator.
16. Flush condenser, lines and evaporator.
17. Install new orifice tube or cleaned expansion valve.
18. Install new receiver-drier/accumulator.
19. Remove inlet, outlet and drain ports from replacement compressor.
20. Drain all lubricant from replacement compressor and install drain plug.
21. Add system capacity of fresh uncontaminated lubricant of correct type to compressor inlet.
22. Attach replacement compressor to its mounting bracket.
23. Install and correctly tension compressor drive belt.
24. Install compressor electrical connections.
25. Attach refrigerant lines to compressor.
26. Mid-position both valves if system has service valves.
27. Evacuate system.
28. Check system for leaks.
29. Charge system with correct type and amount of refrigerant.
30. Check system operation.
31. Return tools to proper location.
32. Clean up work area.
33. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

Technician must possess correct and current certification credentials.

PRODUCT

Faulty air conditioner compressor is removed and replacement is installed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

MEASURE ENGINE HORSEPOWER AND TORQUE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Measure horsepower and torque capability of engine.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure belt-lacing kit, hooks and vice.
6. Inspect machine for safe operation.
   a. Correct amount and type of lubricant
   b. Adequate quantity of correct fuel
   c. Adequate amount of coolant
   d. Correct belt tension
   e. Correctly working parking brake
7. Connect dynamometer to machine power train.
8. Ensure driveline is straight.

9. Apply parking brake to machine and dynamometer.
10. Supply dynamometer with adequate cooling water for horsepower generated.
11. Route exhaust heat and fumes to outside environment.
12. Start engine and warm to operating temperature.
13. Set dynamometer sensing device to coincide with engine power take-off rated speed.
14. Engage power take-off clutch with engine throttle at low idle.
15. Adjust throttle to high idle.
16. Apply dyamometer load to slow engine to rated speed.
17. Record horsepower reading and compare to manufacturers' specifications.
18. Remove load and adjust throttle to low idle.
19. Disengage power take-off clutch.
20. Set dynamometer sensing device to read "torque".
21. Engage power take-off clutch.
22. Adjust throttle to high idle.
23. Apply dynamometer load to slow engine to manufacturers' specified r.p.m.
24. Record torque and power take-off r.p.m. and compare to manufacturers' specifications.
25. Remove load and allow engine to cool five minutes.
26. Shut off engine.
27. Remove water supply and dynamometer.
28. Return tools to proper location.
29. Clean up work area.
30. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Measurement of engine horsepower and torque is made.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY DIESEL ENGINE PERFORMANCE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Diagnose faulty diesel engine performance.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Determine specific performance complaint.
7. Inspect machine for safe operation.
8. Diagnose faulty performance according to manufacturers' guidelines.

9. Troubleshoot problems with low power.
   - a. Check engine horsepower.
   - b. If power is low, make the following checks:
     - 1) Exhaust temperature
     - 2) Exhaust pressure
     - 3) Intake boost pressure
     - 4) Crankcase pressure
     - 5) Fuel consumption
     - 6) Fuel aeration
     - 7) Lubrication pressure
     - 8) Coolant temperature
   - c. Check air cleaner restriction to be certain it is below 25 inches of water.
   - d. Install new fuel filters.
   - e. Check injection pump or injector timing and advance.
   - f. Check valve lash.
   - g. Check camshaft timing.
   - h. Check quality and specific gravity of fuel.
   - i. Check for manifold leaks.
10. Troubleshoot problems with rough running.
    - a. Run engine at various speeds and loads to verify complaint.
    - b. Perform cylinder balance test.
      - 1) Check fuel aeration.
      - 2) Exchange injectors of weak and normal cylinders.
      - 3) Note if weak cylinder is aligned with original weak cylinder injector.
      - 4) If weak cylinder follows one injector, cause is injector or its actuator.
      - 5) If weak cylinder does not follow one injector, go to next step c.
    - c. Perform cylinder leakage test.
    - d. Check timing gear integrity and backlash.
11. Troubleshoot problems with high oil consumption.
    - a. Verify correct amount and type of engine oil.
    - b. Run engine at full load and rated speed according to manufacturers' specifications.
    - c. Measure oil consumption and compare to specifications to verify.
12. Troubleshoot problems with excessive smoke.
    - a. Check turbocharger seals.
    - b. Check injection timing.
    - c. Check valve timing and lash.
    - d. Check fuel delivery setting.
    - e. Check aneroid (fuel/air ratio control) operation.
    - f. Check cooling system performance.
    - g. Check for correct injector parts.
    - h. Check oil pressure.
    - i. Check gaskets and seals.
    - j. Check mechanical condition of engine.
13. Troubleshoot problems with an abnormal noise.
    - a. Check part clearances.
    - b. Check bearing condition.
    - c. Check sound barrier integrity.
    - d. Check lubrication system.
    - e. Check for loose parts.
14. Compare test results with manufacturers' specifications and guidelines to pinpoint defect.

15. Determine necessary action.
16. Return tools to proper location.
17. Clean up work area.
18. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty diesel engine performance is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY SPARK IGNITION ENGINE PERFORMANCE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Diagnose faulty spark ignition engine performance.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Determine specific performance complaint.
7. Inspect machine for safe operation.
8. Diagnose faulty performance, according to manufacturers' guidelines, if engine has self-diagnostic capability or is compatible with an electronic diagnostic tool.
9. Troubleshoot problems with low power.
   a. Check engine horsepower.
   b. Make the following checks.
      1) Crankcase pressure
      2) Coolant temperature
      3) Lubrication pressure

  c. Check that low and high idle are correct.
  d. Check air cleaner restriction to be certain it is below 25 inches of water.
  e. Check spark timing and advance.
  f. Check valve lash.
  g. Check camshaft timing.
  h. Check fuel supply system and quality of fuel.
  i. Check carburetor adjustment or fuel injector operation.
  j. Check for excessive exhaust back pressure and correct exhaust system components.
  k. Check for air induction system leakage.
  l. Check ignition system.

10. Troubleshoot problems with rough running.
    a. Run engine at various speeds and loads to verify complaint.
    b. If rough engine is observed, make the following checks:
       1) Cylinder balance test
       2) Throttle shaft clearance
       3) Governor performance
       4) Carburetor adjustment
       5) Ignition output
       6) Primary ignition system
       7) Secondary ignition system
       8) Quality of fuel
       9) Valve lash
       10) Cylinder leakage test
       11) Mechanical condition of engine
11. Troubleshoot problems with high oil consumption.
    a. Verify correct amount and type of oil.
    b. Run engine at full load and rated speed according to manufacturers' specifications.
    c. Measure oil consumption and compare to specifications to verify.
12. Troubleshoot problems with excessive smoke.
    a. Check choke operation.
    b. Check ignition timing and advance.
    c. Check carburetor adjustment.
    d. Check valve timing and lash.
    e. Check that carburetor size is correct.
    f. Check oil pressure.
    g. Check gaskets and seals.
    h. Check mechanical condition of engine.
13. Troubleshoot problems with an abnormal noise.
    a. Check part clearances.
    b. Check bearing condition.
    c. Check sound barrier integrity.
    d. Check lubrication system.
    e. Check for loose parts.
14. Compare test results with manufacturers' specifications and guidelines to pinpoint defect.
15. Determine necessary action.
16. Return tools to proper location.
17. Clean up work area.
18. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty spark ignition engine performance is accurately diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SERVICE AIR INDUCTION SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Service air induction system of multi-cylinder engine.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Remove dry safety element and cover with duct tape and reinstall.
8. Attach regulated air supply to test port on intake manifold.
9. Brush soapy water solution on entire air induction system.
10. Observe bubbles at leaks.
11. Close induction leaks.
    a. Tighten clamps.
    b. Replace hoses and pipes.
    c. Replace seals and gaskets.

12. Remove regulated air supply and install test port plug.
13. Remove duct tape on safety element.
14. Examine safety element for leaks to determine if it is reusable.
15. Examine main dry type element for plugging and leaks to determine if it is reusable.
16. Install safety element.
17. Install main element.
18. Dispose of used oil in appropriate manner and clean cup if oil bath filter is used.
19. Add correct amount of engine oil to cup and install.
20. Check air cleaner restrictor indicator, switch and wiring.
21. Check any precleaners and aspirators that are used.
22. Examine exhaust side of turbocharger for erosion and leakage.
23. Examine turbocharger discharge plumbing for oil streaks. If oil streaks are found, check
    a. Turbo lubrication drain tube for restriction,
    b. Engine oil pressure at turbo inlet,
    c. Turbine radial and end play, and
    d. Turbo wheel rub.
24. Correct deficiencies and repair or replace turbocharger.
25. Compare results with manufacturers' specifications and guidelines to determine necessary action.
26. Return tools to proper location.
27. Clean up work area.
28. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Air induction system is serviced.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturer guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Service exhaust system of multi-cylinder engine.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Run engine and carefully check for exhaust leaks.
8. Connect vacuum gauge to intake manifold test port if engine is spark ignited.
9. Run engine at 1500 r.p.m. and verify intake manifold vacuum does not drop.
10. Check for restricted exhaust if vacuum drops.

11. Connect pressure gauge to exhaust manifold test port and run engine at rated speed and load for diesel engines. If exhaust pressure exceeds specifications, check
    a. Exhaust restriction,
    b. Fuel system,
    c. Valve timing,
    d. Valve lash,
    e. Exhaust valve condition, and
    f. Head gasket integrity.
12. Check muffler for excessive noise.
13. Check all aspirator connections.
14. Check turbocharger turbine wheel for
    a. Nicks,
    b. Broken blades,
    c. Wheel rub, and
    d. Shaft radial and end play.
15. Check all exhaust piping integrity.
16. Check for turbine wheel housing erosion.
17. Check manifold for erosion. If exhaust manifold leaks, check
    a. Fastener type and torque, and
    b. Manifold warpage and cracks.
18. Correct deficiencies and repair or replace turbocharger, if necessary.
19. Compare results with manufacturers' specifications and guidelines to determine necessary action.
20. Return tools to proper location.
21. Clean up work area.
22. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Exhaust system is serviced.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REMOVE AND INSTALL MULTI-CYLINDER ENGINE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Remove and install multi-cylinder engine.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Park machine on level, smooth, solid surface.
7. Apply machine parking brake.
8. Chock machine's wheels.
9. Remove battery ground strap.
10. Drain engine fluids and dispose of correctly.
11. Shut off fuel supply valve.
12. Remove necessary sheet metal and store in safe location.
13. Tag and identify all electrical connections.
14. Remove all electrical conductors from the engine.

15. Identify and remove all hose and tube connections to engine.
16. Remove exhaust system.
17. Remove starter.
18. Remove all necessary drives, belts, fans, accessories, shrouds, coolers and radiator.
19. Support machine securely at both ends of engine if engine is a structural member of the machine.
20. Attach engine lifting sling.
21. Support and move engine away from bell housing with suitable lifting device.
22. Move engine away from machine and lower to safe and secure location.
23. Attach lifting sling to engine to install engine.
24. Use clutch aligning tool to center clutch disc.
25. Align engine with transmission input shaft and bell housing.
26. Install engine in reverse order of removal.
27. Install new engine fluids.
28. Attach battery ground strap.
29. Turn on and purge fuel supply.
30. Start engine, with clutch disengaged, and test drive machine in both directions.
31. Return tools to proper location.
32. Clean up work area.
33. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Multi-cylinder engine is removed and installed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REBUILD MULTI-CYLINDER ENGINE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Rebuild worn multi-cylinder engine according to manufacturers' procedure and specifications.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Clean outside of engine.
7. Drain engine fluids and dispose of correctly.
8. Disassemble engine, keeping orientation of parts while observing for failed parts.
9. Clean engine in engine cleaner, hot soapy water and/or use mechanical devices.
10. Dry engine parts and protect from dirt and rust.

11. Measure parts for wear including but not limited to:
    a. Valves
    b. Valve guides
    c. Valve seats
    d. Head
    e. Block
    f. Crankshaft and end play
    g. Bearing clearances
    h. Pistons
    i. Damper
    j. Balancer
    k. Air pump
    l. Turbocharger
    m. Piston rings
    n. Connecting rods
    o. Camshaft
    p. Valve train components
    q. Flywheel
    r. Ring gear
    s. Cylinder liner or cylinder bore
    t. Cylinder liner protrusion
    u. Timing gears and backlash
    v. Oil pump
    w. Coolant pump
    x. Fuel system parts
    y. Ignition system parts
12. Evaluate block, cylinder head and manifold for cracks, casting pores and erosion.
13. Determine which parts are usable and non-usable using manufacturers' guidelines.
14. Determine which non-usable parts should be machined.
15. Machine non-usable parts.
16. Replace remaining non-usable parts.
17. Final clean all parts.
18. Lubricate all parts except camshaft lobes, lifters and crankshaft seals with engine oil at assembly.
19. Apply grease-based lubricant to camshaft lobes, lifters and crankshaft seals.
20. Using new seals and sealants, assemble all parts according to manufacturers' recommendations and correct torque procedures.
21. Adjust valve lash.
22. Time fuel system at installation.
23. Install new filters, belts and hoses.
24. Prime lubrication system.
25. Add correct type and amount of fluids to engine.
26. Bleed air from fuel system.
27. Start engine and check for correct operation and correct oil pressure.
28. Recheck fuel timing.
29. Return tools to proper location.
30. Clean up work area.
31. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Multi-cylinder engine is rebuilt to original design.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

BREAK IN REBUILT ENGINE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Break in rebuilt engine according to manufacturers' recommendations.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Check and adjust engine oil and coolant level.
7. Assure an adequate fuel supply.
8. Continuously monitor engine coolant temperature, oil pressure, fluid leaks, abnormal noises and dynamometer coolant temperature.
9. Ensure exhaust is vented correctly and adequate ventilation is provided.

10. Perform break-in procedure. Run engine for prescribed time, load and speed. For example, if dynamometer is used:

Time	Load	Speed
5 minutes	No load	Low idle
5 minutes	No load	½ throttle
5 minutes	¼ load	¾ throttle
10 minutes	½ load	¾ throttle
10 minutes	¾ load	¾ throttle
10 minutes	Full load	Full throttle

11. Run engine three minutes at half throttle and no load before shut down.
12. Advise customer to avoid overloads, excessive idling and no-load operations during first 100 hours of operation.
13. Drain engine oil, change oil filter and fill crankcase with recommended lubricating oil after 100 hours of operation.
14. Return tools to proper location.
15. Clean up work area.
16. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Engine is broken in.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR DIESEL FUEL SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Repair diesel fuel system according to manufacturers' guidelines.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Check serviceability of air cleaner, induction and exhaust systems.
7. Inspect machine for safe operation and that engine is mechanically sound and valves are correctly timed.
8. Check fuel injection timing.
9. Check and adjust, to specifications, engine low and high idle speeds.
10. Check fuel supply pressure.
11. Drain water from supply tank and check for correct and uncontaminated fuel.

12. Install new fuel filters.
13. Check for fuel leaks.
14. Check for injector compression leaks.
15. Ensure fuel supply is adequate to fuel pump.
16. Check speed control linkage.
17. Check fuel "on" and "off" control.
18. Check for unrestricted fuel return path.
19. Check for correct fuel tank vent.
20. Correct and bleed air from system if suction line leaks are found.
21. Evaluate condition of fuel injectors, injector actuation system and fuel pump according to manufacturers' recommended procedures.
22. Repair, replace with new or remanufactured components or send defective components to "Association of Diesel Specialists" certified service center for repair.
23. Use sanitary procedures, install all repaired, remanufactured or new components on engine.
24. Bleed air from fuel system.
25. Start engine and check for correct operation.
26. Return tools to proper location.
27. Clean up work area.
28. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Diesel fuel system is repaired.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR GASOLINE FUEL SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Repair gasoline fuel system according to manufacturers' guidelines.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Check that engine is mechanically sound and valves are correctly timed.
8. Ensure ignition system is operating correctly.
9. Drain water from supply tank, sediment bowl and carburetor bowl.
10. Check for adequate supply of fresh, correct and uncontaminated fuel.
11. Check serviceability of air cleaner, induction and exhaust systems.

12. Check serviceability of fuel filters, screens and supply tank standpipe.
13. Ensure unrestricted flow if there is a gravity supply system.
14. Measure pressure and flow if there is a transfer pump system.
15. Check for fuel leaks.
16. Check fuel "on" and "off" control.
17. Ensure supply tank vent is open and fill cap is serviceable.
18. Check speed control linkage.
19. Ensure choke and linkage are adjusted correctly.
20. Check and adjust for correct float height.
21. Measure throttle shaft, bushings and seal for wear.
22. Measure choke shaft, bushings and seal for wear.
23. Adjust idle mixture to initial setting.
24. Adjust load mixture to initial setting.
25. Ensure that throttle and choke shafts are not binding.
26. Repair or replace with new or remanufactured components after evaluation of all components.
27. Start engine and warm to operating temperature.
28. Set idle speed as low as possible without rolling.
29. Adjust idle mixture to maximum intake manifold vacuum.
30. Connect dynamometer and, with throttle at high idle, load engine to rated speed.
31. Adjust load mixture screw to rich side until revolutions per minute drop.
32. Lean load screw until lost speed is recovered.
33. Set low idle to specifications at minimum throttle setting.
34. Set high idle to specifications at governor with throttle set at maximum.
35. Check acceleration, starting and driveability for acceptable performance. If unacceptable, shut off fuel supply and remove, clean and rebuild or replace carburetor or injection system.
36. Readjust fuel system and recheck engine for acceptable performance.
37. Return tools to proper location.
38. Clean up work area.
39. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Gasoline fuel system is repaired.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TUNE UP SPARK IGNITION SYSTEM.

IL.00.ANR. AMST.28

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Tune up spark ignition system according to manufacturers' guidelines.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Check resistance of each secondary ignition wire and observe integrity of insulation.
8. Check bypass starting voltage at battery side of coil.
9. Check that coil polarity is correct.
10. Check insulated primary circuit resistance.
11. Check ground primary resistance.
12. Replace ignition points.
13. Lubricate ignition point actuator cam.

14. Adjust point gap to specifications.
15. Clean ignition points of residue.
16. Replace condenser.
17. Remove spark plugs.
18. Gap new spark plugs to specifications.
19. Install new spark plugs.
20. Replace distributor cap and rotor.
21. Ensure that plug wires are in correct rotation and in firing order.
22. Static time distributor so that number one plug wire is aligned with rotor as contact points open when number one piston is at top dead center of compression stroke.
23. Check resistance values of modules and appropriate air gaps if ignition system is solid state.
24. Adjust dwell angle to specifications.
25. Check dwell variation.
26. Check ignition system output.
27. Start engine and run at low idle.
28. Adjust dynamic ignition timing to specifications.
29. Check ignition advance at appropriate speeds.
30. Compare all test results with manufacturers' guidelines and recommendations and take appropriate action.
31. Return tools to proper location.
32. Clean up work area.
33. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Spark ignition system is tuned up.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

MEASURE CAMSHAFT LOBE WEAR WITH CAM IN ENGINE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Measure lobe wear of multi-cylinder engine camshaft while it is in engine.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Remove valve cover.
7. Set valve clearance to specifications.
8. Place dial indicator on valve spring retainer or rotator and zero indicator with valve closed.
9. Rotate engine (manually) and measure total indicator reading as valve opens and closes.

10. Repeat procedure on all valves.
11. Compare readings with manufacturers' specifications.
12. Fail lobes that differ from like (intake or exhaust) lobes more than 0.020 inch.
13. Remove camshaft and measure lobes to ensure wear is lobe and not lifter, pushrod, rocker arm or shaft before failing camshaft.
14. Evaluate test results and take appropriate action.
15. Return tools to proper location.
16. Clean up work area.
17. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Camshaft lobe wear is measured with cam in engine.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

MEASURE TIMING GEAR WEAR.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Measure timing gear wear of multi-cylinder engine.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Gain access to driven gear.
7. Set dial indicator so pointer is close to perpendicular with drive gear tooth.
8. Rotate drive gear shaft back and forth while ensuring drive gear does not move.
9. Record total indicator reading.
10. Compare results to manufacturers' guidelines.
11. Evaluate test results and take appropriate action.
12. Return tools to proper location.
13. Clean up work area.
14. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Engine timing gear wear is measured.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

CHECK VALUE TIMING.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Determine if valve timing of multi-cylinder engine is correct.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Remove valve cover.
7. Rotate crankshaft in normal direction until number one piston is at top dead center of compression stroke.
8. Check valve lash adjustment of number one cylinder intake valve.
9. Measure circumference of damper.
10. Measure length of masking tape equal to circumference of damper.

11. Mark 360 equal spaces on masking tape.
12. Attach tape to damper.
13. Attach wire pointer to timing cover and center over zero degree mark on tape.
14. Set up dial indicator on number one cylinder intake valve-spring retainer or rotator.
15. Zero indicator dial.
16. Rotate in engine in normal direction.
17. Observe degree mark under pointer when valve begins to open.
18. Compare results to manufacturers' specifications.
19. Evaluate test results and take appropriate action.
20. Return tools to proper location.
21. Clean up work area.
22. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Correctness of valve timing is determined.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturer guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

ADJUST VALVE CLEARANCE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Adjust valve clearance of multi-cylinder engine.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Start engine and warm to operating temperature.
8. Shut off engine.
9. Remove valve cover.
10. Identify intake and exhaust valves.
11. Rotate crankshaft until number one piston is at top dead center of compression stroke.

12. Using manufacturers' guidelines, adjust the valves that are completely closed by sliding correct feeler gauge between valve stem and rocker arm. Then loosen jam nut and screw adjuster until slight drag is felt at feeler gauge.
13. Tighten jam nut and verify adjustment did not change.
14. Rotate crankshaft 360 degrees and adjust remaining valves that are completely closed.
15. Install valve cover.
16. Start engine and verify correct operation.
17. Shut off engine.
18. Return tools to proper location.
19. Clean up work area.
20. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Valve clearance is adjusted.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY LIQUID COOLING SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Troubleshoot faulty liquid cooling system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Verify cooling system complaint.
8. Move hood out of the way to gain access to cooling system.
9. Ensure accuracy of coolant temperature gauge.
10. Observe for following faults:
    a. Low coolant level
    b. Incorrect type or contaminated coolant
    c. External coolant leaks

  - d. Engine oil with milky appearance
  - e. Plugged radiator or grille screen
  - f. Low engine oil level
  - g. Damaged radiator
  - h. Loose, incorrect or missing fan and coolant pump belts
  - i. Fan clutch inoperative
  - j. Plugged coolant passages in radiator
  - k. Hose deterioration

11. Pressure test radiator cap for leaks.
12. Use thermostat tester to check for correct thermostat operation.
13. Add coolant to top of radiator core.
14. Apply 18 pounds per square inch to radiator.
15. Observe location of leaks at radiator, heater core, engine, coolant pump and plumbing if pressure does not hold for 10 minutes.
16. Look inside engine for casting cracks, pore leaks, erosion, oil cooler, air cooler, head gasket and cylinder liner packings if leak cannot be detected.
17. Check condition of coolant and coolant conditioning filters with test kit.
18. Ensure ignition and fuel injection timing is correct.
19. Determine if engine is overpowered.
20. Determine if engine is being overloaded in operation.
21. Compare all test results to manufacturers' guidelines to pinpoint fault.
22. Determine necessary action.
23. Return tools to proper location.
24. Clean up work area.
25. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty liquid cooling system is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY LUBRICATION SYSTEM.

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SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Troubleshoot faulty lubrication system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Verify lubrication system complaint.
8. Move hood out of the way to gain access to lubrication system.
9. Verify accuracy of engine oil pressure gauge.
10. Ensure accuracy of engine oil temperature gauge.
11. Ensure engine level is correct and not contaminated.
12. Ensure engine lubricant is correct type and viscosity for application.
13. Ensure engine cooling system is operating correctly.

14. Check for the following faults if low oil pressure or abnormal noise is detected:
    a. Clogged cooler or filter
    b. Failed or out-of-adjustment pressure regulating valve
    c. Worn oil pump or failed pump drive
    d. Excessive engine bearing clearance
    e. Clogged oil pump pickup screen
    f. Suction leak on inlet side of oil pump
    g. Coolant leaking into engine oil
    h. Dilution of oil by incomplete combustion
    i. Improper lubrication system maintenance
    j. Oil leak
15. Check for the following faults if high oil pressure is detected:
    a. Clogged oil lines
    b. Failed or out-of-adjustment pressure regulating valve
16. Compare all test results to manufacturers' guidelines to pinpoint fault.
17. Determine necessary action.
18. Return tools to proper location.
19. Clean up work area.
20. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty lubrication system is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

EVALUATE BATTERY.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Perform evaluation of wet cell battery.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Disconnect battery connections starting with ground.
7. Clean battery case and/or terminals.
8. Replace missing vent caps or reject battery.
9. Reject battery if terminals are defective or case is cracked.
10. Test battery.
    a. Electronic tester
        1) If voltage is too low to test, charge or attempt to charge.
        2) If voltage is acceptable, test with electronic tester.
        3) Accept or reject on test results.

   b. High rate discharge tester
      1) If battery passes high rate test, accept battery.
      2) If battery fails high rate test, do three minute charge test.
      3) Accept or reject on results of three minute charge test.

11. Return tools to proper location.
12. Clean up work area.
13. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Battery is evaluated.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SERVICE BATTERY.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Perform maintenance service to wet cell battery.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Remove battery terminal ground connection.
7. Remove battery terminal insulated connection.
8. Mechanically clean battery terminals and cable connectors.
9. Use solution of baking soda and water or commercial cleaner to clean battery and case of corrosion and dirt.
10. Check electrolyte level. If low, add distilled water to correct level.
11. Charge battery if it is below 80 percent charge.

12. Attach battery terminal insulated connection.
13. Attach battery terminal ground connection.
14. Return tools to proper location.
15. Clean up work area.
16. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Wet cell battery is serviced and maintained.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE BATTERY.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace wet cell battery.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Determine correct battery for application using manufacturers' guidelines.
   a. Cranking or deep cycle
   b. Battery Council of America group
   c. Electrical capacity
7. Install correct amount of electrolyte if dry charged.
8. Initial charge new battery.
9. Remove old battery ground cable connection.
10. Remove old battery insulated connection.

11. Remove old battery from machine.
12. Inspect battery retainer for integrity.
13. Install new battery in machine and secure in position.
14. Connect insulated battery cable noting correct polarity.
15. Connect ground battery cable.
16. Start machine to verify correct operation.
17. Return tools to proper location.
18. Clean up work area.
19. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Battery is replaced.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY STARTING SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Perform starting system diagnosis.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation and loose connections.
7. Crank engine with diesel fuel turned off or coil wire high tension lead grounded on spark ignited engine.
    a. Note if engine cranks.
    b. Measure cranking revolutions per minute.

8. Measure available voltage, voltage drops and amperes.
    a. Measure available voltage at cranking motor, if low test battery.
    b. Measure insulated and ground voltage drops of power circuit.
    c. Measure insulated and ground voltage drops of control circuit.
    d. Measure amperes during cranking.
9. Measure torque required to rotate engine.
10. Compare test results with manufacturers' specifications to pinpoint defect.
11. Determine necessary action.
12. Return tools to proper location.
13. Clean up work area.
14. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty starting system is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE STARTER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace defective starter.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Disconnect battery ground cable.
7. Remove and label wires attached to starter and solenoid.
8. Remove fasteners attaching starter to engine.
9. Remove starter from housing noting any shims.
10. Install replacement starter to engine.
11. Check pinion to ring gear mesh and adjust if necessary.
12. Attach wires to starter and solenoid.

13. Connect battery ground cable.
14. Start machine to verify correct operation of starter.
15. Return tools to proper location.
16. Clean up work area.
17. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Defective starter is replaced.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY CHARGING SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Perform charging system diagnosis.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation, loose connections and belt tension.
7. Check battery open circuit voltage.
8. Start engine, if safe to operate, and place throttle at high idle.
9. Check battery voltage for increase. If voltage did not increase or battery charge remains low, do the following:
   a. Turn on all electrical accessories.
   b. Measure insulated charging circuit voltage drop.
   c. Measure ground charging circuit voltage drop.

   d. Measure ampere output of charging unit with carbon pile load and determine if output is within 10% of rated.
   e. If not within 10 percent, full field charging unit and measure amperes.
   f. If not within 10 percent, repair or replace charging unit.
   g. If within 10 percent, measure ampere draw of all machine accessories except starting circuit.
   h. If sum of accessory loads is greater than charging unit output, install a higher rated charging unit or remove required electrical load.

10. Remove resistance if voltage drops are excessive.
11. Determine necessary action.
12. Return tools to proper location.
13. Clean up work area.
14. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty charging system is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE CHARGING UNIT.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace faulty charging unit.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Disconnect battery ground cable.
7. Identify all electrical connections on charging unit.
8. Disconnect all electrical connections from charging unit.
9. Remove fasteners attaching charging unit to engine.
10. Remove charging unit from engine.
11. Install replacement charging unit and adjust belt tension to specification.
12. Attach all electrical connections to charging unit.
13. Connect battery ground cable.
14. Polarize field winding in charging unit if manufacturer specifies.

15. Check battery open circuit voltage.
16. Start engine, raise throttle to high idle and verify voltage increase.
17. Return tools to proper location.
18. Clean up work area.
19. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Defective charging unit is replaced.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DIAGNOSE FAULTY ACCESSORY CIRCUIT.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Perform diagnosis of faulty accessory circuit.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation and loose connections.
7. Turn on accessory circuit, if safe to operate, to verify faulty operation.
8. Operate another electrical circuit to verify battery voltage is adequate.
9. Disconnect electrical connections at element.
10. Apply battery voltage (positive and negative) directly to element.

11. Replace element, if element does not function correctly, and verify circuit is working correctly. If element does not function correctly, do the following:
    a. Check for continuity of fuses, fuse links and circuit breakers.
    b. Check voltage drop of all switches.
    c. Check voltage drop of insulated side of circuit.
    d. Check voltage drop of ground side of circuit.
12. Measure amperage draw of accessory circuit and compare to specifications. If amperage is too high, check for ground on insulated side of circuit and mechanical drag on element.
13. Determine necessary action.
14. Return tools to proper location.
15. Clean up work area.
16. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty accessory circuit is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturer guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR CONDUCTOR.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Repair faulty conductor.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Isolate faulty wire from any voltage source by opening circuit switch or removing battery ground cable.
7. Remove faulty wire from conduit.
8. Cut defective wire at least 1-1/2 inches from other splices or connections.
9. Cut each end of wire back until good conductor and insulator is reached.
10. Strip one-half inch of insulation from each end of wire and install two inches of appropriate size shrink tube on one wire.
11. Select appropriate size crimp clip and center it on overlapped stripped wire ends.

12. Crimp clip in middle and on each end.
13. Apply 50/50 rosin-core solder to hole in back of crimp clip.
14. Center shrink tube on splice and use heat gun to shrink tube tight. (If shrink tube is not available, use splice tape pulled to tension to completely cover splice.)
    a. If conductor is stretched or otherwise too short, two splices will have to be made with adequate length of same wire gauge conductor added to circuit.
    b. If faulty conductor is used as fusible link, use conductor that is four wire gauge smaller than cable it is designed to protect and be certain it is covered with heavy hypolon insulation.
15. Connect battery ground cable and close circuit switch to verify conductor is repaired.
16. Return tools to proper location.
17. Clean up work area.
18. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty conductor is repaired.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR CONNECTOR.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Repair faulty connector.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Isolate wire attached to faulty connector from any voltage source by opening circuit switch or removing battery ground cable.
7. Release terminal from its attaching point to provide access to faulty connector.
8. Identify type and size of connector that is at fault.
9. Remove connector from terminal.
10. Cut faulty connector from its wire.
11. Remove 1/8 - 3/16 inch of insulation.
12. Install any required weather seals.

13. Crimp mechanical clamp of replacement connector to insulation of wire.
14. Crimp electrical clamp of replacement connector to stripped wire conductor.
15. Apply 50/50 rosin-core solder to hole in connector.
16. Ensure that connector locking tang is correctly formed.
17. Push connector into terminal until lock tang is seated.
18. Pull conductor while holding terminal to verify lock up.
19. Reattach terminal to its connecting point.
20. Connect battery ground cable and close circuit switch to verify connector is repaired.
21. Return tools to proper location.
22. Clean up work area.
23. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty connector is repaired.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

PROGRAM PARAMETERS IN ELECTRONIC MONITOR AND/OR CONTROL SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Program correct parameters into machine's electronic monitor and/or control system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Determine parameters desired by customer.
7. Determine parameters mandated by
   a. Manufacturer requirements,
   b. Engine type and size,
   c. Machine accessories,

   d. Drive train type and size,
   e. Safety demands.
8. Determine how parameters are input into machine according to manufacturers' guidelines.
   a. Machine programmable display
   b. Machine switches
   c. Personal computer with appropriate software
   d. Portable electronic diagnostic unit
   e. Combination of above
9. Park machine in safe place with parking brake on.
10. Ensure that machine and fluids are at correct temperature.
11. Ensure battery has minimum of 11 volts and connections are clean and tight.
12. Input parameters exactly as specified by manufacturers' guidelines.
13. Recheck all parameters to verify correct input.
14. Disconnect and remove any diagnostic units from machine.
15. Return tools to proper location.
16. Clean up work area.
17. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Machine's electronic monitor and/or control system is correctly programmed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TROUBLESHOOT FAULTY ELECTRONIC CONTROL SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Troubleshoot faulty electronic control system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Determine machine manufacturer, model and serial number.
7. Gather information regarding current performance from machine operator or other sources.
   a. Abnormal operating characteristics
   b. Number of times events occurred
   c. Operating conditions when abnormalities occurred
   d. Machine service history

8. Inspect machine for safe operating condition.
9. Verify operational abnormality.
10. Check battery condition and terminal connections.
11. Check that electronic control unit has battery voltage applied when switch is on.
12. Test sensors, electronic control units, switches, actuators, connectors and harnesses according to manufacturers' guidelines and using the following tools:
    a. Digital volt-ohm meter
    b. Break out harnesses
    c. Personal computer with appropriate software
    d. Electronic diagnostic units
    e. Appropriate test harnesses and adapters
13. Use self diagnostic capabilities to provide faults or fault codes.
14. Access active and/or logged faults.
15. Use test information, manufacturers' guidelines and digital volt-ohm meter to make specific electrical checks at prescribed test points.
16. Compare test results to specifications to determine course of action.
17. Disconnect and remove any diagnostic units from machine.
18. Return tools to proper location.
19. Clean up work area.
20. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty electronic control system is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

EVALUATE CLUTCH CONDITION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Evaluate ground drive clutch for usable condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Review appropriate documentation to determine which machine and clutch is to be evaluated.
7. Check and adjust, if necessary, all fluid levels of machine.
8. Operate machine until operating temperature is reached.
9. Check for abnormal noise, grabbing, binding, pulsation, sticking, slipping and chatter.

10. Move machine to open area away from other persons and obstacles and check ground drive clutch.
    a. Apply brakes at maximum.
    b. Shift transmission to highest gear.
    c. Move throttle to high idle position.
    d. Gradually engage clutch to verify engine kill.
    e. If engine kills, clutch is usable if no other defects are apparent.
    f. If engine does not kill and machine brakes hold, the clutch and/or hydraulic system is defective.
11. Document any deficiencies and inform supervisor.
12. Return equipment to proper location.
13. Clean up work area.
14. Complete appropriate documentation according to shop policy and procedures

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Ground drive clutch is evaluated for usable condition.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR DRY-TYPE CLUTCH.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Repair non-usable dry-type clutch to usable condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Prepare machine for service.
   a. Power wash external area involved.
   b. Remove battery ground strap.
   c. Use appropriate support stands.
   d. Split (uncouple) machine to access clutch.
7. Inspect and service clutch release mechanism.
8. Replace release bearing.
9. Inspect clutch shaft for service condition.

10. Mark orientation of clutch cover to flywheel.
    a. Remove clutch cover and evaluate pressure plate for flatness, grooves and thickness.
    b. Measure springs for condition and strength.
    c. Evaluate condition of disc for hub wear, damper wear and friction material depth.
11. Inspect flywheel surface for flatness, grooves, thickness and excessive cracks.
12. Inspect ring gear teeth for wear.
13. Inspect mating surfaces of engine and transmission housing.
14. Measure flywheel runout and crankshaft end play.
15. Inspect and correct any fluid leaks to clutch housing.
16. Replace pilot bearing.
17. Assemble clutch with appropriate new, original or reconditioned parts.
18. Use appropriate alignment and lifting tools to assemble and install clutch.
19. Lubricate clutch shaft with light coat of graphite-based high temperature paste.
20. Adjust release finger height.
21. Recouple machine.
22. Adjust clutch free pedal.
23. Remove support stands.
24. Lubricate appropriate linkage.
25. Attach battery ground strap.
26. Confirm clutch is disengaged, transmission is in neutral, brakes are applied and engine throttle is at low idle.
27. Start engine, select lowest forward gear and slowly engage clutch, then disengage clutch.
28. Test drive machine and if safe, check clutch for correctness.
29. Clean up work area.
30. Return tools to proper location.
31. Complete appropriate documentation.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Using the most appropriate procedure clutch is repaired to original design capability.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TROUBLESHOOT FAULTY MECHANICAL TRANSMISSION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Diagnose faulty mechanical transmission.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect transmission fluid level, condition and type.
7. Inspect transmission for fluid leaks and source.
8. Inspect machine for safe working condition.
9. Operate machine with transmission at normal operating temperature if possible.
10. Determine if machine travels at correct smooth speed and direction in all gears.
    a. Note any abnormal noises.
    b. Note lack of motion and abnormal noise in neutral with clutch applied.

11. Check for hard shifting and jumping out of gear with power applied as well as released.
12. Determine necessary action.
13. Return tools to proper location.
14. Clean up work area.
15. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty mechanical transmission is diagnosed using approved procedure.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR MECHANICAL TRANSMISSION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Perform mechanical transmission repair.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Power wash areas surrounding mechanical transmission.
7. Remove battery ground strap.
8. Support machine and remove transmission.
   a. Examine fluid samples for contaminants.
   b. Check vent for function. Repair or replace vent as necessary.
   c. Remove fluid.
9. Inspect all components for visual wear and serviceability.
10. Measure critical bearing preloads.
11. Evaluate serviceability of synchronizer parts.

12. Measure appropriate shaft radial and end play and compare to specifications.
13. Inspect all shift linkages and detents for serviceability.
14. Replace all bearings if fluid is contaminated. Flush all contaminated parts. Replace worn and unserviceable bearings if fluid is not contaminated.
15. Replace all gears, shafts and fasteners that are unserviceable. Heat or cool parts to correct temperature when assembling.
16. Time necessary gears and shafts.
17. Check critical gear backlash for correctness.
18. Install new seals and appropriate sealants.
19. Adjust all bearings for correct clearance or preload.
20. Clean contaminants from inside the case before installing cover on transmission.
21. Install transmission in machine and adjust shift linkages.
22. Remove support stands.
23. Add appropriate quantity and type of lubricant.
24. Connect battery ground strap.
25. Operate machine to verify correct function of transmission.
26. Return tools to proper location.
27. Clean up work area.
28. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Mechanical transmission is repaired.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TROUBLESHOOT FAULTY POWER SHIFT TRANSMISSION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Diagnose faulty power shift transmission.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect transmission fluid level, condition and type.
7. Inspect transmission for fluid leaks and source.
8. Inspect machine for safe working condition.
9. Operate machine with transmission at normal operating temperature, if possible.
10. Determine if machine travels at correct smooth speed and direction in all gears.
    a. Note any abnormal noises.
    b. Check for overheated fluid.
    c. Note lack of motion and abnormal noise in neutral with inching pedal up and down.
    d. Note that gear selector indicator reads correctly.

11. Check that machine does not move with machine parked on steep incline and selector in "park".
12. Change transmission filter if defects are found.
    a. Inspect filter for type of contamination.
    b. Repeat operational test and check for improvement.
13. Connect appropriate test box or laptop computer with correct software if transmission is electronically controlled.
    a. Check that correct parameters are programmed into machine.
    b. Follow manufacturers' guidelines when using tester to aid in diagnosing failure and cause.
14. Identify failed element by comparing test drive results with element applied charts.
15. Pinpoint and verify diagnosis by placing machine on secure stands, connecting appropriate gauges and flow meters, and following manufacturers' troubleshooting guidelines.
    a. Check fluid temperature.
    b. Check regulated pressure.
    c. Select each possible gear and record element lock-up pressure, lube pressure and elapsed shift time.
16. Drain transmission reservoir, connect plumbing to collect any element leakage, connect slave machine and collect element leakage, when applied for all elements, by selecting appropriate gears.
17. Compare actual leaks with maximum guidelines to determine which elements need rebuilding.
18. Determine if defect is supply pressure, valve problem, accumulator, element leakage, element failures or mechanical.
19. Determine necessary action.
20. Return tools to proper location.
21. Clean up work area.
22. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty power shift transmission is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR POWER SHIFT TRANSMISSION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Repair faulty power shift transmission to usable condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Power wash areas surrounding power shift transmission.
7. Remove battery ground strap.
8. Support machine and remove the transmission.
   a. Examine fluid samples for contaminants.
   b. Remove fluid.
9. Disassemble transmission while keeping orientation of parts.

10. Examine parts for wear and reuse.
    a. Plate and disc condition of elements
    b. Thrust and radial bearings
    c. Pumps
    d. Return springs
    e. Valves
    f. Accumulators
    g. Gears
    h. Shafts
    i. Linkages
    j. Control circuit plumbing
    k. Electronic controls, monitors and actuators
    l. Sensors
11. Replace all bearings if fluid is contaminated. Flush all contaminated parts.
12. Reassemble transmission.
    a. Use new parts as necessary.
    b. Correctly time all compound planetary gears.
    c. If necessary, adjust bearings for correct clearance or preload.
    d. Use all new seals, packings, gaskets, seal rings and "o" rings.
    e. Soak element discs in new fluid prior to assembly.
    f. Use new filter.
    g. Use new fluid.
13. Install transmission in machine and adjust linkages.
14. Remove support stands.
15. Attach battery ground strap.
16. Start engine with brakes on and transmission in park.
17. Adjust fluid level.
18. Confirm test pressures per manufacturers' specifications.
19. Operate machine in all gears to verify function of transmission.
20. Return tools to proper location.
21. Clean up work area.
22. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty power shift transmission is repaired.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturer guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TROUBLESHOOT FAULTY HYDROSTATIC TRANSMISSION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Troubleshoot faulty hydrostatic transmission.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Check fluid level, condition and type.
7. Inspect transmission for fluid leaks and source.
8. Inspect machine for safe working condition.
9. Operate machine with transmission at normal operating temperature, if possible.

10. Shift through all speeds and directions.
    a. Observe for neutral creep forward or reverse.
    b. Observe speed transition rate.
    c. Observe correct direction of machine travel.
    d. Note any abnormal noises.
    e. Check for overheated fluid.
11. Move speed ratio lever to forward and reverse to verify engine will kill in both directions.
    a. Range transmission is in high gear.
    b. Brakes are fully applied.
12. Replace transmission filter if test drive is abnormal.
    a. Inspect filter for type of contamination.
    b. Repeat test drive.
13. Connect gauges as follows:
    a. Connect 10,000 p.s.i. gauge in drive pressure port.
    b. Connect 1,000 p.s.i. gauge in servo port.
    c. Connect flow meter in charge circuit loop.
    d. Connect 600 p.s.i. gauge in charge port.
14. Check hydraulic system.
    a. Support drive wheels and operate until fluid reaches operating temperature.
    b. Check drive pressure in both directions with engine at high idle and brakes applied.
    c. Check servo pressure.
    d. Check charge pressure in neutral, forward and reverse.
    e. Check charge circuit flow.
    f. Check fluid temperature.
15. Compare test results with manufacturers' specifications and guidelines to pinpoint defect. Consider
    a. Charge pump,
    b. Main pump,
    c. Motor,
    d. Valves,
    e. Plumbing,
    f. Linkage,
    g. Mechanical drag,
    h. Engine horsepower,
    i. Oil cooler.
16. Determine necessary action.
17. Return tools to proper location.
18. Clean up work area.
19. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty hydrostatic transmission is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR HYDROSTATIC TRANSMISSION.

IL.00.ANR. AMST.54

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
    hearing protection
    eye protection
    clothing
    hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Repair faulty hydrostatic transmission to usable condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Power wash areas surrounding hydrostatic transmission.
7. Remove battery ground strap.
8. Support machine and remove the transmission.
    a. Examine fluid samples for contaminants.
    b. Remove fluid.
9. Disassemble transmission while keeping orientation of parts.

10. Examine parts for wear and reuse.
    a. Linkages
    b. Return springs
    c. Valves
    d. Gears
    e. Shafts
    f. Control circuit plumbing
    g. Slippers and pistons
    h. Blocks
    i. Valve and bearing plates
    j. Trunion bearings
    k. Swash plates
    l. Seals
11. Replace all bearings if fluid is contaminated. Flush all contaminated parts.
12. Reassemble transmission being careful to keep dirt/contamination out.
    a. Use new parts as necessary.
    b. If necessary, adjust bearings for correct clearance, preload and gear backlash.
    c. Lubricate all metal parts with correct transmission oil at reassembly.
    d. Use new filter.
    e. Use new fluid.
13. Install transmission in machine and adjust linkages.
14. Remove support stands.
15. Attach battery ground strap.
16. Start engine with transmission in neutral and brakes on.
17. Adjust fluid level.
18. Slowly release brakes and operate machine at all speeds and directions to verify function of transmission.
19. Return tools to proper location.
20. Clean up work area.
21. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty hydrostatic transmission is repaired.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TROUBLESHOOT FAULTY MECHANICAL FRONT WHEEL DRIVE.

IL.00.ANR. AMST.55

POWER TRAIN SERVICE

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Troubleshoot faulty mechanical front wheel drive.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect mechanical front wheel drive housing fluid level, condition and type.
7. Inspect for fluid leaks and source.
8. Inspect machine for safe working condition.
9. Operate machine.
   a. Observe engagement and disengagement of mechanical front wheel drive.
   b. Observe that any automatic engagement and/or disengagement feature is working.
   c. Note any abnormal noise in mechanical front wheel drive.
   d. Note backlash in gear train.

10. Verify abnormal performance of mechanical front drive electronic control system.
    a. Verify solenoid operation
    b. Verify hydraulic pressure when mechanical front wheel drive is switched to "off".
    c. Verify zero hydraulic pressure when mechanical front wheel drive is engaged.
11. Check drive line integrity.
    a. Shafts
    b. Splines
    c. Yoke bearings
    d. Universal joints
    e. Gears
    f. Bearings
    g. Steering cut stop settings
    h. Wheel attaching points
    i. Rim to tire connection
12. Check clutch if lack of mechanical front wheel drive drive torque is suspected.
    a. Disconnect drive shaft.
    b. With appropriate adapter and torque wrench, measure torque to slip clutch and compare to specifications.
13. Verify that engine horsepower is not above design torque loads of mechanical front wheel drive.
14. Compare test results to manufacturers' guidelines to pinpoint fault.
15. Determine necessary action.
16. Return tools to proper location.
17. Clean up work area.
18. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty mechanical front wheel drive is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR MECHANICAL FRONT WHEEL DRIVE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Repair faulty mechanical front wheel drive to usable condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Power wash areas surrounding mechanical front wheel drive.
7. Remove battery ground strap.
8. Support machine and remove the necessary mechanical front wheel drive components.
   a. Examine fluid samples for contaminants.
   b. Check vent for function. Repair or replace as necessary.
   c. Remove fluid.
9. Inspect all components for visual wear and serviceability.

10. Check ring and pinion and, if necessary, replace.
11. Measure critical bearing preloads and gear backlash.
12. Examine mechanical front wheel drive clutch.
    a. Piston
    b. Seals
    c. Apply springs
    d. Plates and discs
    e. Drum condition
    f. Control mechanism
13. Measure appropriate shaft radial and end play and compare to specifications.
14. Inspect all linkages and detents for serviceability.
15. Replace all bearings if fluid is contaminated. Flush all contaminated parts. Replace unserviceable bearings if fluid is not contaminated.
16. Replace all gears, shafts and fasteners that are unserviceable. Heat or cool to correct temperature when assembling.
17. Time necessary gears and shafts.
18. Install new seals and appropriate sealants.
19. Adjust necessary bearings for correct clearance or preload.
20. Ensure cleanliness on reassembly.
21. Install mechanical front wheel drive on machine and connect linkages and/or controls.
22. Remove support stands.
23. Add appropriate quantity and type of lubricant.
24. Connect battery ground strap.
25. Operate machine to verify correct function of mechanical front wheel drive.
26. Return tools to proper location.
27. Clean up work area.
28. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty mechanical front wheel drive is repaired.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

EVALUATE RING AND PINION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Evaluate ring and pinion for usable condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Check and adjust, if necessary, fluid level in ring and pinion housing.
7. Inspect machine for safe working condition.
8. Operate machine.
   a. Note any abnormal noise, especially high pitch whine.
   b. Check for abnormal jerking and smooth power transfer.
   c. Turn machine full right and left.
   d. Operate machine in both directions with brakes off and applied.
9. Check gear backlash of ring and pinion and compare to specifications.

10. Support machine so drive axles are off ground.
11. Remove access cover and check condition of gear teeth.
12. Examine tooth contact pattern and compare to manufacturers' guidelines.
13. Measure appropriate bearing end play, radial play, and preload.
14. Measure position of pinion gear in case and compare to specifications.
15. Use test results to determine necessary action.
16. Return tools to proper location.
17. Clean up work area.
18. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Ring and pinion is evaluated.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE RING AND PINION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
    hearing protection
    eye protection
    clothing
    hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace faulty ring and pinion with new matched set.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Power wash areas surrounding ring and pinion housing.
7. Remove battery ground strap.
8. Support machine and remove necessary items and fluids to access ring and pinion.
9. Remove ring and pinion taking note of location and thickness of bearing shims.
10. Install only matched ring and pinion set.
11. Install pinion in housing using correct shim pack.

12. Adjust pinion shaft bearing.
13. Install ring gear on carrier.
14. Establish correct bearing preload on ring gear carrier shaft.
15. Adjust gear backlash by transferring shims from one quill to another.
16. Assemble removed items and add appropriate fluid.
17. Remove supports.
18. Attach battery ground strap.
19. Operate machine to verify correct functioning of ring and pinion.
20. Return tools to proper location.
21. Clean up work area.
22. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Ring and pinion are correctly replaced.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

EVALUATE DIFFERENTIAL LOCK.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Evaluate faulty differential lock.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect hydraulic fluid level, condition and type.
7. Inspect machine for safe working condition.
8. Check machine operation at slow speed on unpaved surface.
   a. While locked, steer right and left and note if machine loses steering control.
   b. While moving, tap each brake one at a time and note if steering control returns.
   c. While moving with differential locked, manually disengage lock and note if steering control returns.
   d. If differential lock has automatic control, verify it operates correctly.

9. Check linkage and controls.
10. Check regulated pressure and compare to specifications.
11. Engage lock, check clutch apply pressure and compare to specifications.
12. Disengage lock, check clutch apply pressure to verify zero pressure.
13. Repair hydraulic circuit.
14. Check for proper functioning of control valve.
15. Disassemble differential lock and evaluate condition of parts to determine cause of failure.
16. Determine necessary action.
17. Return tools to proper location.
18. Clean up work area.
19. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty differential lock is evaluated.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR DIFFERENTIAL LOCK.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Repair faulty differential lock to usable condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Power wash areas surrounding differential lock.
7. Remove battery ground strap.
8. Support the machine and remove differential lock.
   a. Examine fluid for samples of contaminants.
   b. Remove fluid.
   c. If contaminated, flush case.
9. Disassemble differential lock while keeping orientation of parts.

10. Examine parts for wear and serviceability.
    a. Shafts
    b. Gears
    c. Drums
    d. Discs
    e. Plates
    f. Bearings
    g. Seals
    h. Valves
    i. Return springs
    j. Linkages
    k. Control circuit plumbing
    l. Electronic controls, monitors and actuators
    m. Sensors
11. Assemble differential lock.
    a. Use new parts as necessary.
    b. Use all new seals, packings, gaskets, seal rings and "o" rings.
    c. Soak element discs in new fluid prior to assembly.
12. Install differential lock in machine and adjust linkages.
13. Install new filter and fluid.
14. Remove support stands.
15. Attach battery ground strap.
16. Start engine and operate machine to verify function of differential lock.
17. Return tools to proper location.
18. Clean up work area.
19. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty differential lock is repaired to original design capability.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TROUBLESHOOT FAULTY FINAL DRIVE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Troubleshoot faulty final drive.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect final drive fluid level, condition and type.
7. Inspect machine for safe working condition.
8. Inspect housing for fluid leaks and source.
9. Operate machine if possible.
10. Determine if machine travels at correct smooth speed in both directions.
    a. Observe if right and left drive are both applying torque.
    b. Note any abnormal noises.

11. Determine type of failure.
    a. Apply right and left steering brakes to check for machine movement.
    b. If machine moves with only one steering brake applied, check final drive, axle, wheel hub and rim to tire integrity on the side that brake is applied.
12. Determine if fault is inside or outside of final drive housing.
13. Decide on necessary action.
14. Return tools to proper location.
15. Clean up work area.
16. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty final drive is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPAIR FINAL DRIVE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Repair faulty final drive to usable condition.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Power wash areas surrounding final drive.
7. Remove battery ground strap.
8. Support machine.
9. Examine final drive fluid for samples of contaminants.
10. Remove fluid from final drive housing.
11. Flush case if fluid is contaminated.
12. Remove final drive unit.
13. Disassemble final drive.

14. Evaluate components for wear and serviceability.
    a. Gears
    b. Shafts
    c. Bearings
    d. Fasteners
    e. Chains
    f. Sprockets
    g. Housing
15. Replace all bearings if fluid is contaminated. Flush all contaminated parts. Replace unserviceable bearings if fluid is not contaminated.
16. Replace all parts that are unserviceable. Heat or cool to correct temperature when assembling.
17. Assemble final drive.
18. Time necessary gears and shafts.
19. Adjust all bearings for correct clearance.
20. Check critical gear backlash for correctness.
21. Install final drive on machine.
22. Remove support stands.
23. Add correct quantity and type of lubricant.
24. Connect battery ground strap.
25. Operate machine to verify correct function of final drive.
26. Return tools to proper location.
27. Clean up work area.
28. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty final drive is repaired to original design capability.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturer guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE DRIVE AXLE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace faulty drive axle.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Power wash areas surrounding axle housing.
7. Remove battery ground strap.
8. Support machine.
9. Examine axle housing fluid for contaminants.
10. Remove wheel or wheels attached to axle.
11. Remove fluid from axle housing.
12. Remove axle housing from machine.
13. Remove axle fasteners.
14. Remove axle from housing.

15. Weld a bead on inner and outer bearing cups to shrink or remove inner and outer bearing cups.
16. Press new inner and outer bearing cones on axle. Heat bearing cones to correct temperature when assembling.
15. Press new inner and outer bearing cups in axle housing. Shrink bearing cups to correct temperature when assembling.
18. Flush axle housing.
19. Assemble axle in axle housing.
20. Adjust axle bearing preload.
21. Install new outer seal.
22. Apply correct seal or sealant on inner axle housing surface.
23. Install correct fasteners to finish assembling axle.
24. Attach axle housing to machine.
25. Add correct quantity and type of lubricant.
26. Attach wheel or wheels to axle.
27. Remove support stands.
28. Connect battery ground strap.
29. Operate machine to verify correct function of axle.
30. Return tools to proper location.
31. Clean up work area.
32. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty drive axle is replaced.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE UNIVERSAL JOINT.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Replace faulty universal joint.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure machine is blocked from moving.
7. Remove U-joint from yoke.
8. Collapse shaft to move bearing cups out of yoke.
9. Remove shaft from machine and inspect for damage.
10. Mark orientation before separation to keep phasing correct if drive shaft is pulled apart at slip joint.
11. Remove two remaining bearing cups from yoke of U-joint being replaced. Mark orientation of cross grease point.
12. Remove cross from shaft.

13. Remove any yoke bore raised metal.
14. Place drive shaft in a vice and check yoke lug bores for excessive wear and alignment.
15. Place new cross into yoke with lube point oriented correctly.
16. Apply anti-seize compound to outside diameter of four new bearing assemblies.
17. Press bearing assembly flush to face of end yoke.
18. Install new locking devices to correct torque.
19. Tap with ball peen hammer directly in center of bearing assembly cap or at base of yoke if bearing assembly binds.
20. Grease new joint with correct lube until grease purges from all four bearings.
21. Install drive shaft on machine being correct with phasing.
22. Grease slip joint.
23. Operate machine to verify correct function of U-joint.
24. Return tools to proper location.
25. Clean up work area.
26. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty universal joint is replaced.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

CHANGE HYDRAULIC FLUID AND FILTER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Remove hydraulic fluid and filter from machine and install new filter and fluid.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Machine's hydraulic fluid and filter is removed and disposed of in an approved manner.

New filter and correct amount and type fluid is installed.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Operate machine until it reaches operating temperature and retract all hydraulic cylinders.
7. Shut off machine and ensure that it cannot move.
8. Determine location of hydraulic drain plug, filter location, capacity and type of fluid.

9. Place drain tub beneath drain plug.
10. Remove drain plug and allow all fluid to drain.
11. Install drain plug and torque to specifications.
12. Place drain tub beneath hydraulic filter.
13. Remove filter and allow fluid from filter base and filter to drain.
14. Obtain correct new filter, filter seal and fluid for system.
15. Lubricate filter seal with new hydraulic fluid.
16. Install new hydraulic filter and tighten to specifications.
17. Add smaller than capacity amount of new hydraulic fluid to system until fluid appears near full mark on indicator.
18. Start machine and operate all hydraulic functions.
19. Add hydraulic fluid to full indicator.
20. Check system operation.
21. Return tools to proper location.
22. Clean up work area.
23. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Hydraulic fluid and filter are changed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TROUBLESHOOT FAULTY HYDRAULIC SYSTEM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Diagnose faulty machine hydraulic system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ask operator or other representative the following questions:
   a. What is the operational complaint?
   b. When did it first occur?
   c. How was the machine being operated when the fault first occurred?
   d. Is it continuous or intermittent?
   e. If intermittent, what are the circumstances when the fault occurs?
   f. What is the recent service and maintenance history of the machine?
   g. Are there any other circumstances that may be related to the fault?

7. Inspect machine for safe operation.
8. Check fluid level, condition, type, contaminants and discoloration.
9. Inspect hydraulic system for fluid leaks and source.
10. Observe mechanical apparatus of hydraulic system for breaks, bends, binding, non-standard accessories, overloading and broken drives.
11. Operate machine hydraulic system to verify complaint.
12. During operation, observe and answer the following questions:
    a. Are there any hydraulics?
    b. Are there any unusual noises?
    c. Are hydraulics sluggish?
    d. Which, if any, hydraulic functions operate correctly?
    e. Does fluid smell burned?
    f. Are there any external leaks while functions are used and not used?
    g. Are there any internal leaks or restrictions when feeling for excessively hot hydraulic lines and passages?
    h. Do systems full cycle in all directions?
13. Check cycle times of all functions.
14. Determine which pressures are not within specifications.
15. Pinpoint fault by accurately measuring flows, temperatures, r.p.m.'s, pressures and cycle times.
16. Determine necessary action.
17. Return tools to proper location.
18. Clean up work area.
19. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty machine hydraulic system is diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

DETERMINE SOURCE OF FLUID LEAK.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Determine source of leak in hydraulic system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ask operator or other representative the following questions:
   a. Have you noticed how long the system has been leaking?
   b. Have you noticed evidence of any external leakage?
   c. Have you noticed excess fluid entering any other reservoirs in the machine?
   d. What recent service and maintenance has been done on the machine?
   e. How much fluid per day needs to be added to the machine to replace fluid that has leaked?
   f. Is there any machine operation that seems to accelerate the leak?

7. Inspect machine for safe operation.
8. Observe the exterior of machine for evidence of oil leak.
9. Check fluid level of all machine reservoirs.
10. Add fluid to correct level if hydraulic reservoir is low.
11. Power wash complete machine.
12. Operate all hydraulic functions under load.
13. Observe machine surface for evidence of leak.
14. Dry surface while observing source of leak if leak cannot be pinpointed.
15. Add prescribed amount and type of fluorescent oil additive to hydraulic fluid reservoir if leak has not yet been pinpointed.
16. Operate machine while shining a black light at all lines, passages and other reservoirs to pinpoint source of fluid leak.
17. Check for cross contamination to other reservoirs if no external leak is observed.
18. Evaluate operator input, all test data and manufacturers' guidelines to determine exact location and cause of leak.
19. Determine necessary action.
20. Return tools to proper location.
21. Clean up work area.
22. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Source of hydraulic system leak is determined.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Flush contaminants from lines and reservoir of hydraulic system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Run machine and retract all hydraulic cylinders.
7. Park machine on level surface, shut off and ensure that it cannot move.
8. Remove cover on hydraulic reservoir.
9. Place container under reservoir drain plug.
10. Remove drain plug and allow all fluid to drain into recovery container.
11. Disconnect all hydraulic lines and passages as is practical and drain fluid.
12. Remove hydraulic filter and drain fluid.
13. Connect siphon gun to shop air.
14. Obtain appropriate size container of approved and safe solvent.

15. Place siphon hose into solvent container.
16. Spray solvent with siphon gun at all accessible areas of hydraulic reservoir.
17. Spray solvent into each accessible line and collect flush solvent at opposite end of passage.
18. Dry all lines, passages and reservoir area.
19. Install reservoir drain plug and torque.
20. Install new hydraulic filter.
21. Fill hydraulic system to correct level.
22. Install reservoir cover.
23. Check system operation.
24. Return tools to proper location.
25. Dispose of used fluid and solvent in environmentally correct method.
26. Clean up work area.
27. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Contamination in hydraulic system lines and reservoir are safely flushed from system.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE HYDRAULIC PUMP.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace faulty pump for machine hydraulic system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Park machine on level surface and ensure that it cannot move.
7. Operate hydraulic controls until force is removed from hydraulic actuators.
8. Shut off engine.
9. Remove battery ground cable.
10. Operate hydraulic controls to remove pressure from hydraulic system.
11. Remove covers to gain access to faulty hydraulic pump.
12. Remove suction, discharge and remaining lines from pump.
13. Remove pump drive mechanism.

14. Attach lifting sling to pump and support with hoist if pump is too large to lift.
15. Remove pump attachment fasteners.
16. Remove pump from machine.
17. Lift replacement pump to position on machine.
18. Add clean hydraulic fluid to inlet of replacement pump.
19. Rotate pump drive shaft in normal direction by hand to prime.
20. Connect pump fasteners and torque.
21. Connect pump drive mechanism.
22. Connect suction, discharge and any remaining lines to pump.
23. Replace hydraulic fluid and filter.
24. Replace pump access covers using new seals.
25. Attach battery ground cable.
26. Check system operation.
27. Check and adjust hydraulic fluid level.
28. Return tools to proper location.
29. Clean up work area.
30. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty hydraulic pump is replaced with a new or remanufactured unit.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE HYDRAULIC VALVE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace faulty valve for machine hydraulic system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Park machine on level surface and ensure that it cannot move.
7. Operate hydraulic controls until force is removed from hydraulic actuators.
8. Shut off engine.
9. Remove battery ground cable.
10. Operate hydraulic controls to remove pressure from hydraulic system.
11. Remove covers to gain access to faulty hydraulic valve.
12. Disconnect any electrical connectors on valve.
13. Remove all lines connected to valve.
14. Remove valve attachment fasteners.

15. Remove valve from machine.
16. Position new or remanufactured valve onto machine with new seals.
17. Connect valve fasteners and torque.
18. Connect all lines to valve.
19. Connect any electrical connectors to valve.
20. Install valve access covers.
21. Connect battery ground cable.
22. Start engine and check operation of valve.
23. Check and adjust hydraulic fluid level.
24. Return tools to proper location.
25. Clean up work area.
26. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty hydraulic valve is replaced with new or remanufactured unit.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

REPLACE HYDRAULIC CYLINDER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace faulty cylinder for machine hydraulic system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and isposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Park machine on level surface and ensure that it cannot move.
7. Operate hydraulic valve until force is removed from cylinder to be replaced.
8. Shut off engine.
9. Remove battery ground cable.
10. Support parts of machine that are supported by cylinder to be removed.
11. Operate valve that controls cylinder to be replaced so that pressure is relieved.
12. Loosen fluid lines attached to cylinder and remove them.

13. Attach lifting sling and hoist and support cylinder if cylinder is too heavy to lift manually.
14. Remove cylinder attachment fasteners.
15. Remove cylinder from machine.
16. Position replacement cylinder on machine.
17. Connect cylinder fasteners.
18. Connect fluid lines to cylinder loosely.
19. Start engine and slowly operate cylinder in both directions until air is bled and only fluid leaks from line connections.
20. Shut off engine.
21. Tighten cylinder line connections.
22. Check and adjust hydraulic fluid level.
23. Start engine and check operation of cylinder.
24. Return tools to proper location.
25. Clean up work area.
26. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty hydraulic cylinder is replaced with new or remanufactured unit.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

WELD FRAME STRUCTURE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Weld machine frame crack to original strength.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Park machine on level surface and ensure that it cannot move.
7. Disconnect battery ground cable.
8. Disconnect alternator output terminal.
9. Clean crack area of frame of oil, grease, loose scale, rust, paint and other material.
10. Dry frame surface.
11. Determine type and thickness of metal to be welded.
12. Support machine frame with jack and stands so frame is in its original position if necessary.

13. Drill one-eighth inch hole at tip of crack.
14. V-out the full length of crack to depth of two-thirds of stock thickness.
15. Clamp copper or aluminum bar on opposite side of groove.
16. Put on welder's helmet with correct density of dark colored lens, protective clothing and leather gloves.
17. Adjust shield arc welder.
18. Connect ground clamp close to frame crack but away from weld spatter.
19. Operate welder to deposit weld material to overfill V-groove.
20. Peen surface of weld.
21. Grind weld flush with frame.
22. Remove chill strip.
23. Grind a V groove on opposite side of frame deep enough to reach weld metal.
24. Clamp chill strip on opposite side of groove.
25. Overfill groove with weld metal making full penetration.
26. Peen surface of weld.
27. Remove chill strip.
28. Grind weld flush with frame.
29. Select reinforcement stock of same material and strength of frame.
30. Cut reinforcement piece sufficiently larger than crack.
31. Clamp reinforcement piece over one side of frame weld and weld to frame.
32. Remove ground clamp.
33. Touch up weld areas with appropriate color paint.
34. Connect alternator output terminal.
35. Connect battery ground cable.
36. Start and check operation of machine.
37. Return tools to proper location.
38. Clean up work area.
39. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Crack in machine frame is repaired by welding to original strength.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturer guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

ADJUST STEERING TOE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Adjust machine steering toe to manufacturers' specifications.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Drive machine to parking spot while steering straight ahead.
7. Park machine on smooth, level surface and ensure that it cannot move.
8. Determine correct toe adjustment and record.
9. Measure distance from inside steer wheel rims at hub height in front of axle spindle. Make same measurement to rear of axle spindle.
10. Loosen cross tube clamps on left and right side of machine.

11. Rotate cross tube until specified toe is achieved.
12. Tighten cross tube clamps on left and right side of machine.
13. Start machine and check operation of steering system.
14. Return tools to proper location.
15. Clean up the work area.
16. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Machine steering toe is adjusted.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

EVALUATE STEERING.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Determine serviceability of machine steering system.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ask operator or other representative if they are aware of any steering system deficiencies.
7. Inspect machine for safe operation.
8. Start engine and turn steering wheel full left and full right and note the following:
   a. Wheels should cut left and right to stop.
   b. Steering wheel effort should be smooth and lack rough spots.
9. Release steering wheel in straight ahead position and note if steering wheel moves in either direction.

10. Measure amount of steering wheel free play.
11. Drive machine at road speed and check for the following:
    a. Wheel shimmy
    b. Wandering
    c. Darting
    d. Hard steering
    e. Over steering
12. Evaluate any deficiencies that have been noted.
    a. Check tire pressure of steering wheels.
    b. Check type, condition and amount of steering fluid.
    c. Check integrity of steering linkage and suspension components.
    d. Check wheel balance.
    e. Check for machine overload.
    f. Check for loose wheels.
    g. Check for worn or loose wheel bearings.
    h. Check for wheel brake drag.
    i. Check for improper toe adjustment.
13. Connect hydraulic test equipment and check appropriate pressures, flow rates and fluid temperatures if source of abnormality has not yet been determined.
14. Evaluate all test data to determine cause of any steering deficiency.
15. Determine necessary action.
16. Return tools to proper location.
17. Clean up work area.
18. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Serviceability of machine steering system is determined.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed depend on manufacturer and particular item.

REPLACE WHEEL BEARINGS.

IL.00.ANR. AMST.75

STEERING, BRAKES, CHASIS AND FRAME SERVICE

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Replace both bearings of machine's non-drive wheel.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Inspect machine for safe operation.
7. Park machine on level surface and ensure that it cannot move.
8. Raise machine frame and install jack stand under frame so that wheel is clear of floor.
9. Lower machine until supported by jack stand.
10. Remove dust cap.
11. Remove and discard cotter key.
12. Remove wheel bearing nut and washer.

13. Remove outer wheel bearing cone.
14. Lift wheel from spindle.
15. Remove grease seal from hub.
16. Remove inner bearing cone.
17. Clean grease from spindle and inside hub.
18. Drive out inner and outer bearing cups.
19. Drive new inner and outer bearing cups into hub until stop is reached.
20. Pack new inner and outer bearings with correct lubricant.
21. Place new inner bearing cone into hub and drive a new grease seal on hub.
22. Fill hub area between bearings half full with correct lubricant.
23. Install wheel on spindle.
24. Place new outer bearing cone on spindle.
25. Install washer and wheel bearing nut.
26. Tighten adjusting nut to 50 foot pounds of torque while rotating wheel.
27. Loosen nut while wheel is still rotating and tighten nut finger tight.
28. Install new cotter pin.
29. Drive on dust cap.
30. Raise machine frame and remove jack stand.
31. Lower machine to floor.
32. Operate machine and check operation of new bearings.
33. Return tools to proper location.
34. Clean up work area.
35. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Faulty machine wheel bearings are removed and new replacements are installed and adjusted.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

TROUBLESHOOT DEFECTIVE BRAKES.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Diagnose defective machine brakes.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ask operator or other representative the following questions:
   a. What is the operational complaint?
   b. When did it first occur?
   c. How was the machine being operated when the fault first occurred?
   d. Does the fault always occur or is it intermittent?
   e. Does the machine pull to one side when braking?
   f. Are there any unusual sounds or smells?

    g. Do the brakes overheat?
    h. What is the recent service and maintenance history of the machine?
    i. Does the brake fluid leak?
    j. Are there any other circumstances that may be related to the fault?
7. Inspect machine for safe operation.
8. Check type, condition and level of brake fluid.
9. Observe brake system for evidence of fluid leaks.
10. Add brake fluid if necessary.
11. Make operational check of brake system asking the following questions:
    a. In high gear and full throttle, will the brakes kill the engine?
    b. Does the machine pull when the brakes are applied?
    c. Do the brakes drag when not applied?
    d. Are there unusual noises or smells?
    e. Do right and left brakes have equal strength?
    f. Is excess heat detected in the brake system?
    g. Are brake pedals and control linkage free of binding?
    h. If brakes are hydraulic or power assisted, is the assist portion working?
    i. Do the manual brakes work?
    j. Does the brake pedal feel spongy?
12. Evaluate test data and determine if it is necessary to connect hydraulic diagnostic test equipment to diagnose any defects in hydraulic portion of brake system.
13. Disassemble foundation portion of brake system and evaluate the following if observations to this point have pinpointed brake fault:
    a. Brake drum condition
    b. Brake rotor condition
    c. Wheel cylinder for leakage
    d. Brake shoe condition
    e. Brake pad condition
    f. Disc caliper condition
    g. Shoe return springs
    h. Condition of brake actuation hardware
14. Compare all test data to manufacturers' guidelines to pinpoint brake deficiencies.
15. Determine necessary action.
16. Return tools to proper location.
17. Clean up work area.
18. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Defective machine brakes are diagnosed.

PROCESS

Performance elements are listed in appropriate sequence for completing skill: however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

ADJUST WHEEL SPACING

IL.00.ANR. AMST.77

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Adjust tractor rear drive wheel spacing to owner's specifications.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Ensure that owner's requested wheel spacing falls within manufacturers' recommended safe operating range.
7. Park tractor on level surface and ensure that it cannot move.
8. Place jack under correct jacking point for one rear axle.
9. Raise wheel off ground and place jack stand under axle.
10. Disconnect front wheel drive shaft if tractor has mechanical front drive.

11. Remove all paint, dirt and rust from axle.
12. Place wheel in sling support to prevent wheel from tipping.
13. Clean jack bolt hole threads and lubricate.
14. Follow manufacturers' procedure for loosening wheel hub.
15. Determine if wheel needs to be dished in or out.
16. Slide wheel off axle and turn around to obtain correct wheel dish.
15. Slide wheel on axle until dimension from exact center of tractor to center of tire tread is one-half of wheel tread setting.
18. Tighten hub bolts.
19. Repeat procedure on remaining axle.
20. Make sure there is a minimum of two inches clearance from wheel and tire to all other tractor components except axle.
21. Ensure that three-point hitch is adjusted to avoid interference with tires.
22. Reconnect front wheel drive shaft if tractor has mechanical front drive.
23. Remove jacks and stands.
24. Drive tractor forward and reverse while turning and braking.
25. Stop tractor and re-torque hub to specified values.
26. Check hub bolt torque after first 30 minutes of field use and every 10 hours until torques stabilize.
27. Return tools to proper location.
28. Clean up work area.
29. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Tractor rear drive axle wheel spacing is adjusted to owner's specification.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

BALLAST TRACTOR FOR APPLICATION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Appropriate documentation
- Manufacturers' guidelines and technical resources
- Correct work environment
- Basic tools and shop equipment
- Personal Protective Equipment (PPE)
- Personal safety practices concerning:
  - hearing protection
  - eye protection
  - clothing
  - hand and power tool usage
- Environmental and safety standards in accordance with local, state and federal regulations
- Shop policy and procedures

WORK TO BE PERFORMED

Install correct amount of ballast in correct location for tractor.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Determine application and type of implement to be used by tractor.
7. Record the following:
   a. Tractor make and model
   b. Two-wheel or four-wheel drive

   c. Front axle powered or unpowered
   d. Field working speed
   e. Number, type and size of tires
   f. Implement hitch type
   g. Desired wheel slip range

8. Determine weight split and pounds per horsepower required.
9. Determine location, type and amount of ballast to be used.
10. Install ballast to tractor using correct mounting hardware and torques.
11. Adjust tire pressures to correct value.
12. Operate tractor in application and monitor wheel slip and power hop.
12. Change travel speed, load or ballast until desired result is obtained if power hop exists or wheel slip is not in desired range.
14. Return tools to proper location.
15. Clean up work area.
16. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Correct amount of ballast is installed in correct location on tractor for desired application.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Split tractor power unit at rear of engine.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Park tractor on level surface and ensure that it cannot move.
7. Disconnect battery ground cable.
8. Drain coolant.
9. Remove all necessary panels, hood and sheet metal.
10. Drain hydraulic fluid from housing if necessary.
11. Disconnect necessary electrical conductors and identify.

12. Remove any necessary gauge components.
13. Shut off fuel supply valve.
14. Disconnect and cap all necessary fluid lines and identify.
15. Disconnect or remove any necessary pump or accessory drives.
16. Disconnect speed control linkage.
17. Remove fuel shut-off cable if equipped.
18. Disconnect refrigerant couplers if equipped.
19. Remove air conditioning compressor and hang it on rear of tractor with wire if tractor has air conditioning and does not have disconnect couplers.
20. Attach appropriate splitting stand to front and rear sections of tractor.
21. Ensure that weight is distributed on stands so that tipover will not occur on separation.
22. Support any necessary components with spacers.
23. Adjust height of splitting stands to support weight of tractor.
24. Remove clutch housing-to-engine cap screws.
25. Move one section of tractor away to provide adequate service access while safely guiding linkage, wires and lines.
26. Return tools to proper location.
27. Clean up work area.
28. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Tractor is safely split at rear of engine for service access.

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Appropriate documentation
Manufacturers' guidelines and technical resources
Correct work environment
Basic tools and shop equipment
Personal Protective Equipment (PPE)
Personal safety practices concerning:
  hearing protection
  eye protection
  clothing
  hand and power tool usage
Environmental and safety standards in accordance with local, state and federal regulations
Shop policy and procedures

WORK TO BE PERFORMED

Remove operator's compartment from tractor.

PERFORMANCE CRITERIA

Skill is completed without error using approved procedure.

Skill is completed in flat rate time multiplied by 1.25.

PERFORMANCE ELEMENTS

1. Wear safety glasses.
2. Comply with personal safety practices concerning clothing, hand and power tool usage, correct ventilation and safe lifting and securing techniques.
3. Comply with environmental safety standards concerning handling, storage and disposal of hazardous materials in accordance with applicable regulations.
4. Check technical information and applicable bulletins to identify approved procedure.
5. Secure appropriate tools, equipment and components required to complete procedure.
6. Park tractor on level surface with adequate overhead clearance and ensure that it cannot move.
7. Disconnect battery ground cable.
8. Drain cooling system.
9. Remove all necessary panels, hood and sheet metal.
10. Remove floor mat.

11. Shut off fuel supply valve.
12. Disconnect necessary electrical conductors and identify.
13. Disconnect heater hoses and identify.
14. Disconnect refrigerant couplers if equipped.
15. Remove air conditioning compressor with lines and hang on operator's compartment if tractor has air conditioning and does not have disconnect couplers.
16. Disconnect the following necessary control linkages:
    a. Transmission
    b. Hydraulic
    c. Clutch
    d. Throttle
    e. Brake
    f. Rock shaft
    g. Power takeoff
    h. Fuel shutoff
17. Disconnect, plug and identify all necessary remaining fluid lines.
18. Remove operator's compartment from tractor and set on support stand.
19. Return tools to proper location.
20. Clean up work area.
21. Complete appropriate documentation according to shop policy and procedures.

PERFORMANCE ASSESSMENT CRITERIA

All procedures are completed in accordance with manufacturers' guidelines.

Environmental safety concerns for appropriate regulations are followed.

PRODUCT

Tractor operator's compartment is safely removed for service access or replacement

PROCESS

Performance elements are listed in appropriate sequence for completing skill; however, the sequence may vary due to manufacturers' guidelines and/or shop policies and procedures.

It may not be necessary to perform all tasks. Actual tasks performed will depend on manufacturer and particular item.

Academic Skills	Skills (and related knowledge) contained in the subject areas and disciplines addressed in most national and state educational standards, including English, mathematics, science, etc.
Assessment	A process of measuring performance against a set of standards through examinations, practical tests, performance observations and/or the completion of work portfolios.
Content Standard	A specification of what someone should know or be able to do to successfully perform a work activity or demonstrate a skill.
Critical Work Functions	Distinct and economically meaningful sets of work activities critical to a work process or business unit which are performed to achieve a given work objective with work outputs that have definable performance criteria. A critical work function has three major components: · **Conditions of Performance:** The information, tools, equipment and other resources provided to a person for a work performance. · **Work to Be Performed:** A description of the work to be performed. · **Performance Criteria:** The criteria used to determine the required level of performance. These criteria could include product characteristics (e.g., accuracy levels, appearance, etc.), process or procedure requirements (e.g., safety, standard professional procedures, etc.) and time and resource requirements. The IOSSCC requires that these performance criteria be further specified by more detailed individual performance elements and assessment criteria.
Credentialing	The provision of a certificate or award to an individual indicating the attainment of a designated set of knowledge and skills and/or the demonstration of a set of critical work functions for an industry/occupational area.
Illinois Occupational Skill Standards and Credentialing Council (IOSSCC)	Legislated body representing business and industry which establishes skill standards criteria, endorses final products approved by the industry subcouncil and standards development committee and assists in marketing and dissemination of occupational skill standards.
Industry	Type of economic activity, or product or service produced or provided in a physical location (employer establishment). They are usually defined in terms of the Standard Industrial Classification (SIC) system.

Industry Subcouncil	Representatives from business/industry and education responsible for identifying and prioritizing occupations for which occupational performance skill standards are adapted, adopted or developed. They establish standards development committees and submit developed skill standards to the IOSSCC for endorsement. They design marketing plans and promote endorsed skill standards across the industry.
Knowledge	Understanding the facts, principles, processes, methods and techniques related to a particular subject area, occupation or industry.
Occupation	A group or cluster of jobs, sharing a common set of work functions and tasks, work products/services and/or worker characteristics. Occupations are generally defined in terms of a national classification system including the Standard Occupational Classification (SOC), Occupational Employment Statistics (OES) and the Dictionary of Occupational Titles (DOT).
Occupational Cluster	Grouping of occupations from one or more industries that share common skill requirements.
Occupational Skill Standards	Specifications of content and performance standards for critical work functions or activities and the underlying academic, workplace and occupational knowledge and skills needed for an occupation or an industry/occupational area.
Occupational Skills	Technical skills (and related knowledge) required to perform the work functions and activities within an occupation.
Performance Standard	A specification of the criteria used to judge the successful performance of a work activity or the demonstration of a skill.
Product Developer	Individual contracted to work with the standard development committee, state liaison, industry subcouncil and IOSSCC for the adaptation, adoption or development of skill standards content.
Reliability	The degree of precision or error in an assessment system so repeated measurements yield consistent results.

Skill	A combination of perceptual, motor, manual, intellectual and social abilities used to perform a work activity.
Skill Standard	Statement that specifies the knowledge and competencies required to perform successfully in the workplace.
Standards Development Committee	Incumbent workers, supervisors and human resource persons within the industry who perform the skills for which standards are being developed. Secondary and postsecondary educators are also represented on the committee. They identify and verify occupational skill standards and assessment mechanisms and recommend products to the industry subcouncil for approval.
State Liaison	Individual responsible for communicating information among all parties (e.g., IOSSCC, subcouncil, standard development committee, product developer, project director, etc.) in skill standard development.
Third-Party Assessment	An assessment system in which an industry-designated organization (other than the training provider) administers and controls the assessment process to ensure objectivity and consistency. The training provider could be directly involved in the assessment process under the direction and control of a third-party organization.
Validity	The degree of correspondence between performance in the assessment system and job performance.
Workplace Skills	The generic skills essential to seeking, obtaining, keeping and advancing in any job. These skills are related to the performance of critical work functions across a wide variety of industries and occupations including problem solving, leadership, teamwork, etc.

ILLINOIS OCCUPATIONAL SKILL STANDARDS AND CREDENTIALING COUNCIL

Margaret Blackshere	AFL-CIO
Judith Hale	Hale Associates
Michael O'Neill	Chicago Building Trades Council
Janet Payne	United Samaritans Medical Center
Gene Rupnik	Hospitality Industry
Jim Schultz	Illinois Retail Merchants Association Walgreen Company
Larry Vaughn	Illinois Chamber of Commerce

AGRICULTURE AND NATURAL RESOURCES SUBCOUNCIL

Lanny Anderson	Black Hawk College, East Campus
Steve Bailey	Family Tree & Garden Center
Rick Butler	Pekin Hardwood Lumber Co., Inc.
Thomas Guth	Lexington High School
Harold Hawkinson	Farm Owner/Operator
Paul Julius	Executive Director Midwest Food Processors Association
John Kraft	Owner Kraft Fertilizer, Inc.
Glen Nichols	President Precision Scales
Richard W. Nichols	Bureau of Land & Water Resources
Tony Romelo	Illinois Laborers and Contractors Construction Apprenticeship and Training Program
Hugh David Scates	Pat Scates and Sons
Sharon Schwarz	Subcouncil Chair Schwarz Nursery
Lue Walters	Assistant State Conservationist for Community Assistance
Tom Wiles	State Liaison (Retired) Illinois State Board of Education
William Schreck	State Liaison Illinois State Board of Education

APPENDIX D

AGRICULTURE MACHINERY SERVICE TECHNICIAN STANDARDS DEVELOPMENT COMMITTEE

Lanny Anderson	Blackhawk College
Dave Braun	Altorfer, Inc.
Steve Burin	Kishwaukee College
Greg McCallum	Sloan Implement Co.
Nick Rummel	Stark Excavating
Bryan Schmidgall	Schmidt-Marcotte, Inc.
Sharon Schwarz	Schwarz Nursery
Tony Sloan	Caterpillar
Richard Buck Tillotson	Western Illinois University
Dave Wilson	University of Illinois-Urbana
Steve Johnson	Product Developer Illinois Central College (Retired)
Tom Wiles	State Liaison (Retired) Illinois State Board of Education
William Schreck	State Liaison Illinois State Board of Education

A. Developing an Employment Plan	1.	Match interests to employment area.
	2.	Match aptitudes to employment area.
	3.	Identify short-term work goals.
	4.	Match attitudes to job area.
	5.	Match personality type to job area.
	6.	Match physical capabilities to job area.
	7.	Identify career information from counseling sources.
	8.	Demonstrate a drug-free status.
B. Seeking and Applying for Employment Opportunities	1.	Locate employment opportunities.
	2.	Identify job requirements.
	3.	Locate resources for finding employment.
	4.	Prepare a resume.
	5.	Prepare for job interview.
	6.	Identify conditions for employment.
	7.	Evaluate job opportunities.
	8.	Identify steps in applying for a job.
	9.	Write job application letter.
	10.	Write interview follow-up letter.
	11.	Complete job application form.
	12.	Identify attire for job interview.
C. Accepting Employment	1.	Apply for social security number.
	2.	Complete state and federal tax forms.
	3.	Accept or reject employment offer.
	4.	Complete employee's Withholding Allowance Certificate Form W-4.
D. Communicating on the Job	1.	Communicate orally with others.
	2.	Use telephone etiquette.
	3.	Interpret the use of body language.
	4.	Prepare written communication.
	5.	Follow written directions.
	6.	Ask questions about tasks.
E. Interpreting the Economics of Work	1.	Identify the role of business in the economic system.
	2.	Describe responsibilities of employee.
	3.	Describe responsibilities of employer or management.
	4.	Investigate opportunities and options for business ownership.
	5.	Assess entrepreneurship skills.
F. Maintaining Professionalism	1.	Participate in employment orientation.
	2.	Assess business image, products and/or services.
	3.	Identify positive behavior.
	4.	Identify company dress and appearance standards.
	5.	Participate in meetings in a positive and constructive manner.
	6.	Identify work-related terminology.
	7.	Identify how to treat people with respect.

G. Adapting to and Coping with Change	1. Identify elements of job transition. 2. Formulate a transition plan. 3. Identify implementation procedures for a transition plan. 4. Evaluate the transition plan. 5. Exhibit ability to handle stress. 6. Recognize need to change or quit a job. 7. Write a letter of resignation.
H. Solving Problems and Critical Thinking	1. Identify the problem. 2. Clarify purposes and goals. 3. Identify solutions to a problem and their impact. 4. Employ reasoning skills. 5. Evaluate options. 6. Set priorities. 7. Select and implement a solution to a problem. 8. Evaluate results of implemented option. 9. Organize workloads. 10. Assess employer and employee responsibility in solving a problem.
I. Maintaining a Safe and Healthy Work Environment	1. Identify safety and health rules/procedures. 2. Demonstrate the knowledge of equipment in the workplace. 3. Identify conservation and environmental practices and policies. 4. Act during emergencies. 5. Maintain work area. 6. Identify hazardous substances in the workplace.
J. Demonstrating Work Ethics and Behavior	1. Identify established rules, regulations and policies. 2. Practice cost effectiveness. 3. Practice time management. 4. Assume responsibility for decisions and actions. 5. Exhibit pride. 6. Display initiative. 7. Display assertiveness. 8. Demonstrate a willingness to learn. 9. Identify the value of maintaining regular attendance. 10. Apply ethical reasoning.
K. Demonstrating Technological Literacy	1. Demonstrate basic keyboarding skills. 2. Demonstrate basic knowledge of computing. 3. Recognize impact of technological changes on tasks and people.
L. Maintaining Interpersonal Relationships	1. Value individual diversity. 2. Respond to praise or criticism. 3. Provide constructive praise or criticism. 4. Channel and control emotional reactions. 5. Resolve conflicts. 6. Display a positive attitude. 7. Identify and react to sexual intimidation/harassment.
M. Demonstrating Teamwork	1. Identify style of leadership used in teamwork. 2. Match team member skills and group activity. 3. Work with team members. 4. Complete a team task. 5. Evaluate outcomes.

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